Truckee Sanitary District
Hydraulic Model Assistance

# SEWER SYSTEM HYDRAULIC MODEL UPDATE

FINAL DRAFT | July 2019

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Ryan F. Orgill,

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Section 1

# BACKGROUND

The Truckee Sanitary District (District) is responsible for the collection and conveyance of wastewater within the greater Truckee area. The District's collection system is separated into four major basins: Martis Valley, Donner Lake, Tahoe Donner, and Glenshire. Due to license size restrictions, the District has developed four separate hydraulic models (one for each basin) using the InfoSewer® wastewater collection system hydraulic modeling software application developed by Innovyze (formerly MWH Soft). The District has previously completed a model verification and a capacity analysis on the Martis Valley hydraulic model in 2015. The other three hydraulic models have been constructed, but no model verification or system analysis tasks have been completed to date. The District originally asked Carollo to calibrate and analyze the Donner Lake, Tahoe Donner, and Glenshire basins. The District later requested that Carollo Engineers, Inc. (Carollo) also update and re-analyze the Martis Valley system.

The objectives of this study were to:

- Review the existing Donner Lake, Tahoe Donner, Glenshire, and Martis Valley hydraulic models
- Update the hydraulic models based on recommendations developed during the review process
- Develop wet weather flow parameters
- Analyze historical flow monitoring and rainfall data to ensure the modeled dry and peak wet weather flows are reasonably replicated by the hydraulic models
- Identify capacity deficiencies under existing and build-out conditions, based on the updated hydraulic models
- Provide recommended improvements to mitigate the capacity deficiencies
- Conduct a trigger analysis to help the District track the timing of future system improvements

Section 2

# HYDRAULIC MODEL REVIEW AND UPDATE

The District's existing hydraulic models for the Donner Lake, Glenshire, Martis Valley, and Tahoe Donner basins were reviewed to understand the model development assumptions and methodology. The models were also checked for data input errors (including pipe sizes, slopes, and friction/roughness coefficients).

The District's models were updated to include the following:

- Manholes and gravity pipes upstream of wet wells (where upstream infrastructure was missing)
- Inverts, based on the District's GIS contour layers, were assigned to the chambers (force main junctions)
- Force main start and stop invert elevations were added (if missing), assuming five feet ground cover
- 3-point pump curves and pump operating/speed set points (if provided)
- Updated dry weather diurnal patterns (discussed in Section 5.1)
- Wet weather scenarios (existing and build-out)
- Wet weather response parameters (discussed further in Section 5.2)

### 2.1 Recommendations for Future Modeling Efforts

After reviewing the existing hydraulic models and flow monitoring data, Carollo recommends the following modifications and/or updates in order to increase the robustness of future modeling efforts:

- Innovyze is expected to sunset the InfoSewer package in the future, at which time the District will have to switch over to a different platform. Upgrading to a newer software (particularly InfoSWMM or similar) offers many advantages, including more robust hydraulic calculations, ability to simulate rain on snow events, and more options for modeling pump curves and lift stations.
- Verify accuracy of existing flowmeter data.
- Perform field pump tests and update pump curves in the model, especially for lift stations with outdated pump information.
- Maintain a database where differences in pump operation, maintenance, and controls during dry and wet weather are recorded and updated over time.

Section 3

# HISTORICAL FLOW MONITORING DATA

This section summarizes the historical dry and wet weather flow data provided by the District as part of this project.

### 3.1 Flow Monitoring Sites

The District has 22 permanent flow monitoring sites located throughout the collection system. Table 1 lists the flow monitoring sites along with the flow meter type and the diameters for the sewers where the meters are installed. Figure 1 shows the locations of the flow monitoring sites in the Donner Lake, Glenshire, Martis Valley, and Tahoe Donner basins. Flow data collected at the flow monitoring sites between January 2016 and February 2017 was analyzed to determine periods of peak dry weather flow and to identify significant rainfall events.

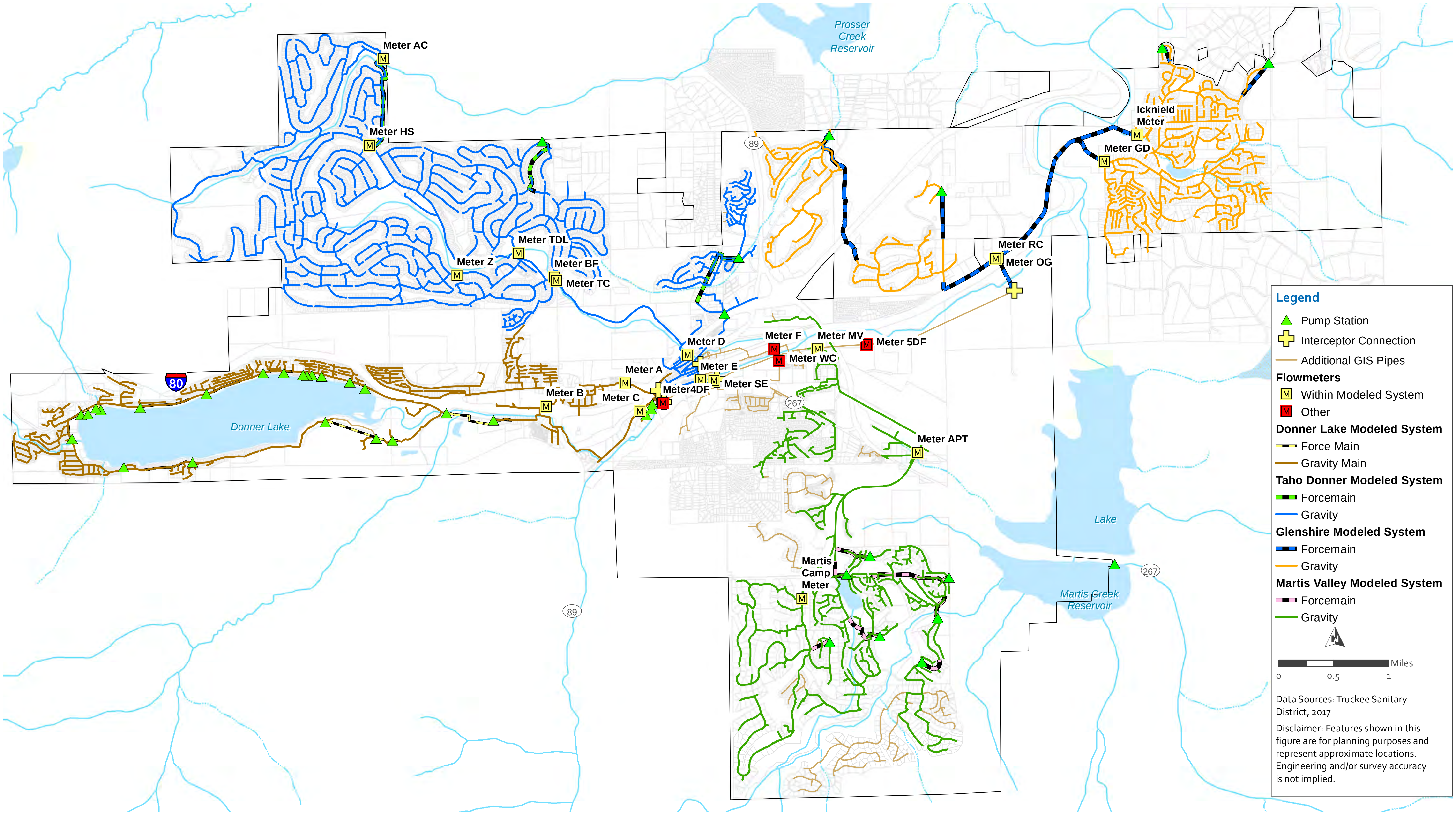


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Figure 1
Existing Wastewater Collection System and Flow Monitoring Locations

TRUCKEE SANITARY DISTRICT

Table 1 Flow Monitoring Locations

| Site | Diameter (in.) | Location |
|---|---|---|
| **Donner Lake** | | |
| A | 8 | Donner Pass Road east of Levon Avenue |
| B | 10 | Northeast of I-80 and CA 89 |
| C | 15 | West River Street and River Park Place |
| **Tahoe Donner** | | |
| AC | 8 | Campground (13901 Alder Creek Road) |
| BF | 10 | East Euer Valley Road east of Lausanne Way |
| TC | 15 | East Euer Valley Road east of Lausanne Way |
| HS | 12 | Northwoods Boulevard northwest of Hillside Drive |
| TDL | 12 | Northwoods Boulevard east of Hansel Avenue |
| Z | 12 | Zermatt Drive west of Northwoods Boulevard |
| D | 18 | Bridge Street south of I-80 |
| E | 18 | Bridge Street and Riverside Drive |
| SE | 24 | South East River Street east of Brockway Road |
| **Glenshire** | | |
| GD | 10 | Glenshire Drive and Light Hill Place |
| GC(1) | 8 | Glenshire Drive west of Overland Trail |
| RC(1) | 14 | Glenshire Drive west of Overland Trail |
| **Martis Valley** | | |
| MV | 18 | West of Glen Carlson Memorial Boulevard (south of Truckee River) |
| APT | 18 | Truckee Tahoe Airport Road |
| MC | 8 | Schaffer Mill Road, north of Valhalla Drive |
| WC(2) | 8 | Riverview Drive, south of East River Street |

Notes:
(1) Mag-Meter located on a pressurized pipe. All others are Parshall flumes located on gravity main.
(2) Only a portion of the WC tributary area is included in the District's model.

## 3.2 Dry Weather Flow Monitoring Results

The Town of Truckee is a tourist destination with a significant percentage of part-time residents. For this reason, the District experiences much higher base flows during holiday weekends, such as the Fourth of July, New Year's Day, and Labor Day. These high occupancy days are most appropriate to use for capacity analysis purposes.

Hourly flow data collected from January 2016 through February 2017 was used to validate the simulated dry weather flows in the model. Because of random data gaps and the relatively wide accuracy range of parshall flumes, several high occupancy days were chosen to validate the model:

- January 1, 2016
- May 30, 2016
- July 4, 2016
- September 5, 2016
- December 31, 2016

Figure 2 shows an example of the dry weather flows measured at Meter Site Z (Tahoe Donner Basin) for the high occupancy days shown above. As shown on Figure 2, the flows measured during each day are somewhat variable.

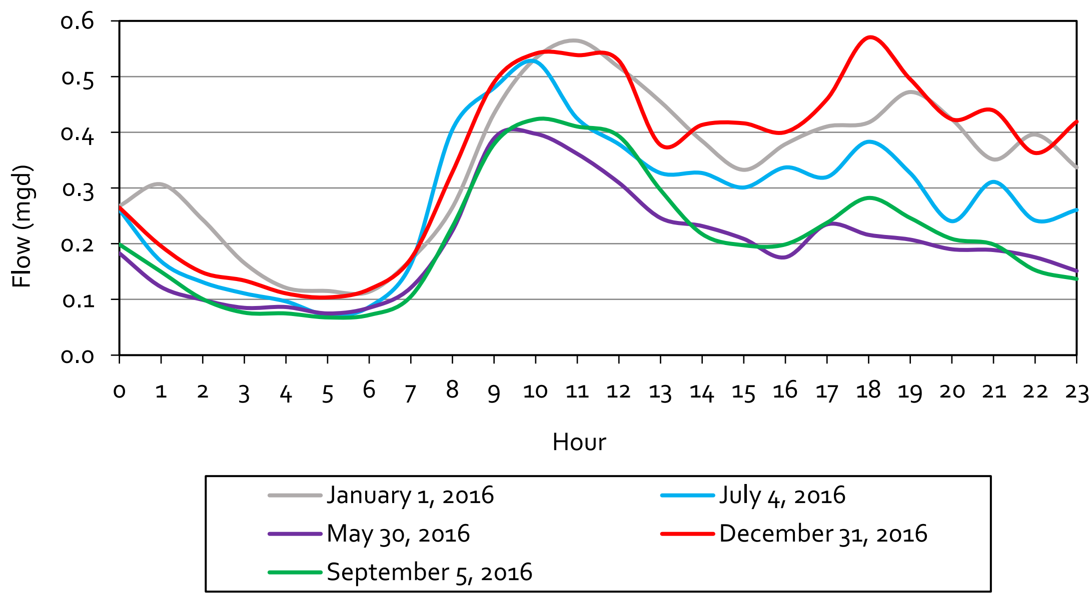



Figure 2 Example Dry Weather Flows (Meter Site Z; Tahoe Donner Basin)

Characteristic dry weather 24-hour diurnal flow patterns were developed for each of the flow monitoring sites based on flow patterns from the high occupancy days. Because of the variability in the flow data between the high occupancy days, the diurnal patterns for each site were based on the most representative high occupancy day. A modified diurnal pattern was created for several sites where the peak hour flows from the historical high occupancy days were very low, indicative of a meter roll over. Figure 3 shows an example diurnal pattern developed for meter site B (Donner Lake basin).

## 3.3 Rainfall Data

Rainfall data from January 1, 2016 through February 28, 2017 was provided by the District for three rain gauges. The location of each rain gauge is shown on Figure 1. Rainfall data was collected at random intervals, which was then aggregated into hourly data for the wet weather validation effort. The rain gauge located at the District's office administration building was out of service starting January 12, 2017. Review of the rainfall data showed several major rainfall events in January and February, 2017. The highest daily rainfall amount recorded at each rain gauge during this period occurred on January 8, 2017. Table 2 summarizes the total rainfall recorded at each rain gauge during the January 8 rainfall event, as well as over the entire January-February 2017 timeframe.

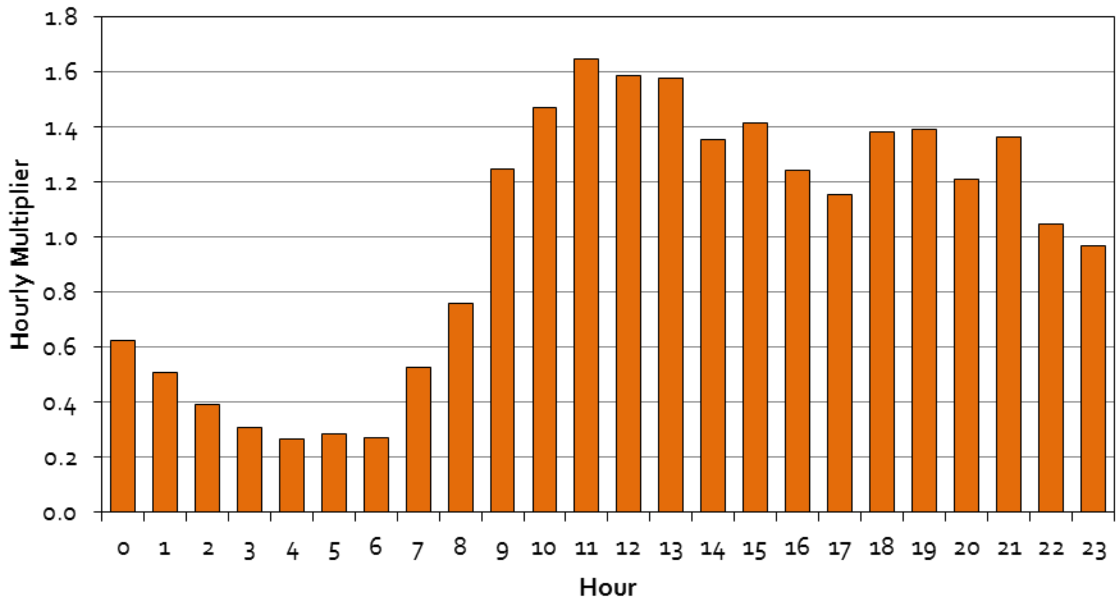



Figure 3 Example Diurnal Pattern (Meter Site B; Donner Lake Basin)

Table 2 Rainfall Summary

| Rain Gauge (Basin) | Total Rainfall January 8, 2017 (Inches) | Total Rainfall Jan 1 - Feb 28, 2017 (Inches) |
|---|---|---|
| Lift Station No. 5 (Donner Lake) | 6.21 | 54.31 |
| Alder Creek (Tahoe Donner) | 6.43 | 32.91 |
| Office Admin (Glenshire/Martis Valley) | 3.36 | 8.54(1) |

Notes:
(1) Office Admin rain gauge data offline after 1/12/17.

### 3.4 Wet Weather Flow Monitoring Results

The flow monitoring data was also evaluated to determine how the collection system responds to wet weather events, or the infiltration/inflow (I/I) response. Because the January 8, 2017 rainfall amount represents the highest daily rainfall recorded during the flow monitoring period, it was used to develop the wet weather verification scenario, which is described further in Section 5.2. The January 8, 2017 storm was a "rain on snow" event, which has historically produced the highest rates of I/I in the District's collection system.

Figure 4 shows an example of the wet weather response at Site HS (located in the Tahoe Donner basin) during the January 8, 2017 wet weather event. Figure 4 illustrates the volume of I/I that entered the system from the collection system upstream of Site HS. The grey area is the base sanitary flow while the light green area is the measured flow from the flow monitoring period. As can be seen in the figure, a significant amount of I/I does enter the system during wet weather events.

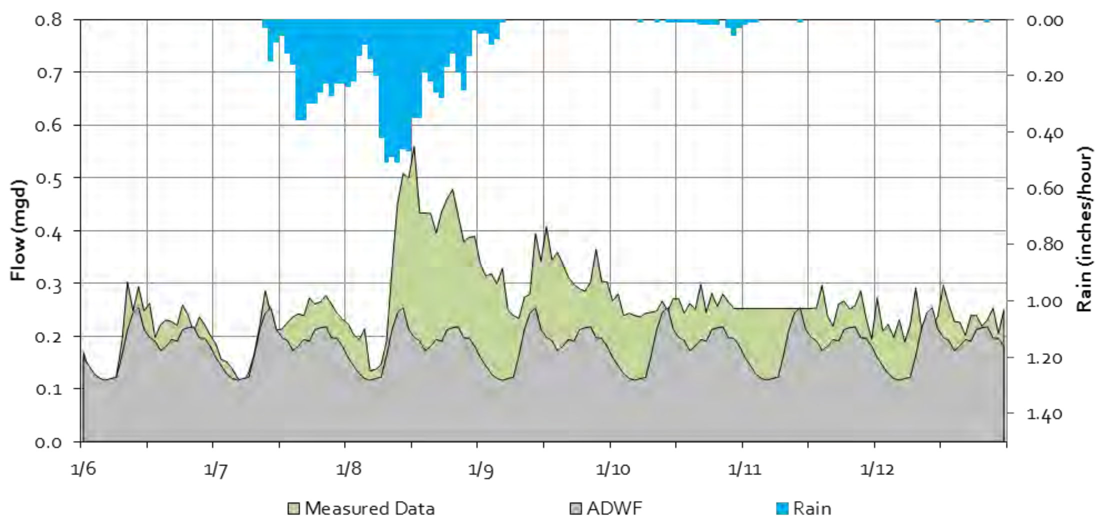



Figure 4 Example Wet Weather Flow Response (Meter Site HS in Tahoe Donner)

Section 4

# DESIGN FLOWS

This section summarizes the existing and build-out wastewater loads provided in the model, the design storm, and the existing and projected peak wet weather flows (PWWFs).

## 4.1 Existing and Build-Out Wastewater Flows

Table 3 summarizes the total existing and build-out wastewater loads that were provided by the District. These wastewater loads represent high occupancy dry weather flows. The total base wastewater loads were reviewed with the District and found to be reasonable to what is expected for an existing and build-out high occupancy day. As shown in Table 3, the Glenshire basin is expected to have the most growth between now and build-out, with the existing flows increasing by approximately 176-percent at build-out.

Table 3 Wastewater Loading Summary

| Basin | Total Existing Wastewater Loads (mgd) | Total Build-Out Wastewater Loads (mgd) |
|---|---|---|
| Donner Lake | 0.73 | 1.19 |
| Tahoe Donner | 1.52 | 2.22 |
| Glenshire | 0.42 | 1.16 |
| Martis Valley | 0.78 | 1.98 |

## 4.2 Design Storm

Design storms are rainfall events used to analyze the performance of a collection system under extreme wet weather events. The first step in the development of the design storm is to define its recurrence interval and rainfall duration. The recurrence interval is based on the probability that a given rainfall event will occur or be exceeded in any given year. For example, a "100-year storm" means there is a 1 in 100 chance that a storm as large, or larger, than this event will occur at a specific location in any year. Duration is the length of time in which the rainfall occurs and is typically in hours.

Typical design storms for wastewater collection systems in California range from 5-year events to 25-year events (typically with 24-hour durations). NOAA Atlas 14, serves as the industry standard for determining total rainfall depth at specified frequencies and durations in California. The 10-year and 25-year rainfall amounts for each basin are listed in Table 4. As shown, the January 8, 2017 rainfall event is classified as a 25-year storm for the Donner Lake Basin, between a 10-year and 25-year storm for the Tahoe Donner Basin, and between a 2-year and 5-year storm for the Glenshire and Martis Valley Basins.

Table 4 Design Storm

| Rain Gauge (Basin) | Total Rainfall January 8, 2017 (Inches) | 10-Year, 24-Hour Storm Event Rainfall (Inches)(1) | 25-Year, 24-Hour Storm Event Rainfall (Inches)(1) | NOAA Storm Classification(1) |
|---|---|---|---|---|
| Lift Station No. 5 (Donner Lake) | 6.21 | 4.99 | 6.06 | 25-Year |
| Alder Creek (Tahoe Donner) | 6.43 | 5.61 | 6.81 | Between 10-Year and 25-Year |
| Office Admin (Glenshire/Martis Valley) | 3.36 | 4.11 | 4.98 | Between 2-Year and 5-Year |

Notes:
(1) Source: NOAA Atlas 14. Rainfall amounts may vary depending on exact location within the basin.

Because the historical January 2017 storm event was equivalent to a 25-year storm for one of the basins, a 25-year storm event was chosen as the design storm. The distribution of the design storm was based on the historical January 8, 2017 rainfall event for the Donner Lake Basin. The distribution pattern for the design storm was shifted to peak at 8 a.m. and scaled to equal the 25-year rainfall amount for each basin. Figure 5 shows the design storms for each basin.

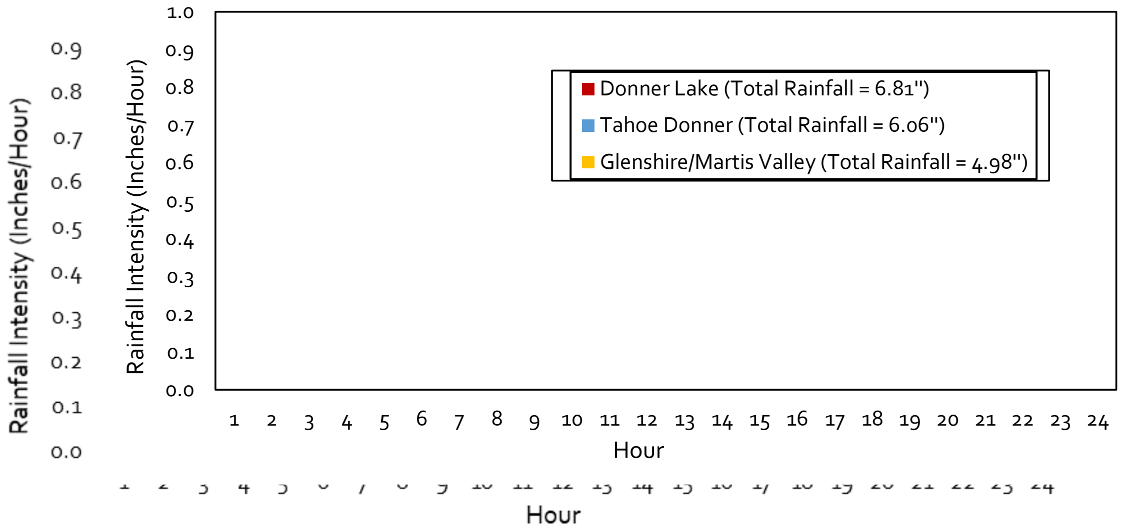



Figure 5 Design Storms

## 4.3 Design Storm Flows

Wet weather I/I, which occurs during and after rainfall events, increases flows in the collection system. The PWWF is the highest observed hourly flow that occurs following the design storm event, and is typically used for designing sewers and lift stations. The District's sewers and lift stations were evaluated based on their capacity to convey the PWWF under existing and build-out (high occupancy) conditions.

The existing and build-out PWWF were derived throughout the four basins based on the hydraulic modeling results. This was accomplished by routing the historical design storm on top of the existing and build-out high occupancy ADWF. Peak I/I rates for future growth areas (e.g., vacant areas within the existing service area, growth areas outside of the current service area, etc.) were based on the I/I parameters developed during the wet weather flow validation process (see Section 5.2).

Table 5 summarizes the average day flow (high occupancy day) and the simulated PWWF under existing and build-out conditions for each basin. As shown on Table 5, the peaking factors under existing conditions range from 2.64 to 5.21 and the peaking factors under build-out conditions range from 2.42 to 3.55.

Table 5 Peak Wet Weather Flow Summary

| Basin | Existing | | | Build-Out | | |
|---|---|---|---|---|---|---|
| | ADWF(1) (mgd) | PWWF(2) (mgd) | Peaking Factor | ADWF(1) (mgd) | PWWF(2) (mgd) | Peaking Factor |
| Donner Lake | 0.73 | 2.56 | 3.51 | 1.19 | 3.67 | 3.08 |
| Tahoe Donner | 1.52 | 4.02 | 2.64 | 2.22 | 5.75 | 2.59 |
| Glenshire | 0.42 | 1.64 | 3.89 | 1.16 | 2.81 | 2.42 |
| Martis Valley | 0.78 | 4.06 | 5.21 | 1.98 | 7.03 | 3.55 |

Notes:
(1) Average Dry Weather Flow (ADWF) based on wastewater loads during high occupancy day.
(2) Peak Wet Weather Flow (PWWF) based on simulated maximum flow following design storm event (includes high occupancy base dry weather flow).

Section 5

# HYDRAULIC MODEL VERIFICATION

In order to confirm the wastewater flows generated by the District's hydraulic models, the models were validated against the historical flow monitoring data provided by the District. This section presents the validation results for the existing dry and wet weather scenarios.

## 5.1 Dry Weather Flow Verification

Flow data collected from January 2016 through February 2017 was used to verify the dry weather flow. As discussed in Section 3.2, the metered flow from several high occupancy days were compared to the model simulated flows (the model simulated flows included existing wastewater loads as provided by District staff, which were developed assuming high occupancy and a wastewater flow of 230 gallons per equivalent dwelling unit [gpd/EDU]). Figure 6 shows an example dry weather validation result for Site Z (Tahoe Donner Basin). The diurnal pattern chosen from this particular site was based off hourly data from December 31, 2016. Dry weather flow validation results for each flow monitoring site are provided in Appendix A. The results were reviewed with District staff and found to be reasonable. Therefore, no changes were made to the existing wastewater loads provided by the District.

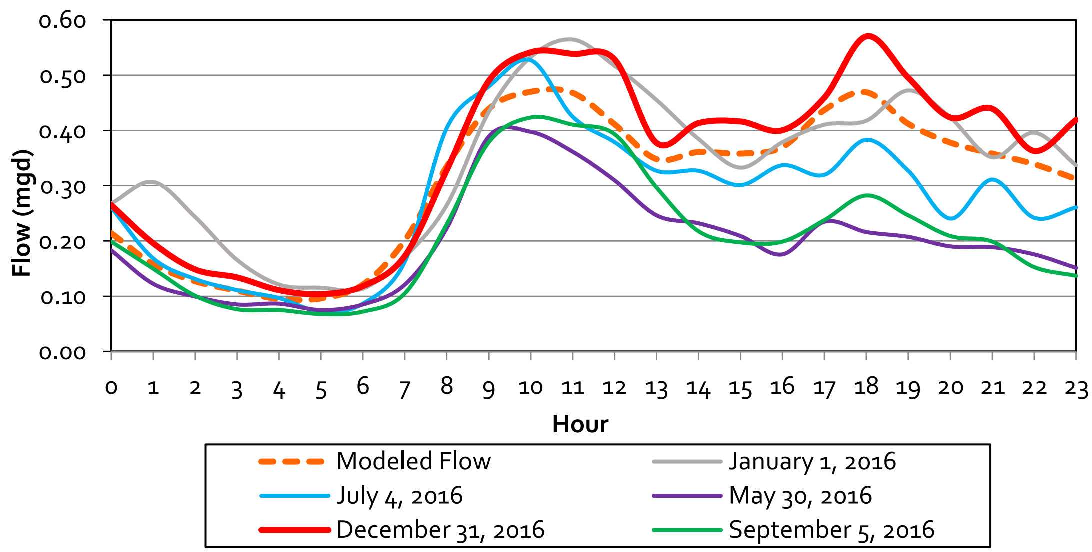



Figure 6 Example Dry Weather Flow Verification (Meter Site Z; Tahoe Donner Basin)

## 5.2 Wet Weather Flow Verification

The following sections describe the wet weather validation methodology and results.

### 5.2.1 Wet Weather Flow Validation Process

The wet weather flow (WWF) validation process enables the hydraulic model to accurately simulate I/I entering the collection system during a large storm. As outlined below, the WWF verification process consists of several elements:

- **Identify rainfall events.** The WWF validation process consists of running model simulations of historical rainfall events based on data collected as part of the flow monitoring program. The goal of any wet weather flow monitoring program is to capture and characterize a system's response to a significant rainfall event, preferably during wet antecedent moisture conditions.

  The selection of a particular storm or group of storms is based on a review of the flow and rainfall data. For WWF validation, the model was run from January 6-12, 2017, and calibrated to one main rainfall event that occurred during this timeframe (January 8, 2017). The January 8, 2017 rainfall event was the most significant rainfall event for the District in at least a decade.

  In order to run a model simulation for the January 8, 2017 rainfall event, the hourly rainfall data were input into the model. Each flow monitoring tributary area, or basin, was assigned a specific rainfall hyetograph, which was calculated for each basin based on the rainfall data collected at the rain gauges.

- **Define Rainfall Derived I/I (RDII) tributary areas.** For the WWF scenarios, RDII flows are superimposed on top of the dry weather flow (DWF). The model calculates RDII by assigning "RDII Inflows" to each node in the model. RDII inflows consist of both a unit hydrograph and the total area that is tributary to the model node. The RDII tributary areas were calculated based on parcel point GIS layers provided by the District. The area associated with each manhole was used in the model update for the RDII process.

  The tributary area provides a means to transform hourly rainfall depth from the rainfall hyetographs into a rainfall volume. The rainfall volume is transformed into actual RDII flows using the unit hydrograph, as described in the next step.

- **Create I/I parameter database and modify to match field measured flows.** The main step in the WWF validation process involves creating custom unit hydrographs for each flow monitoring tributary area using the "RTK Method," which is widely used in collection system master planning. Using the RTK Method, the RDII unit hydrograph is the summation of three separate triangular hydrographs (short term, medium term, and long term), which are each defined by three parameters: R, T, and K. R represents the fraction of rainfall over the sewer shed that enters the collection system; T represents the time to peak of the hydrograph; and K represents the ratio of time to recession to the time to peak. Therefore, there are a total of nine separate variables associated with each unit hydrograph. Figure 7 shows the shape of an example unit hydrograph.

  The hydrographs utilize the R-Values (percent of rainfall that enters the collection system) calculated for each basin to simulate I/I. The nine variables in each unit hydrograph were initially set based on engineering judgment and then adjusted until the model simulated flows (both peak flows and average flows) matched closely with the field measured flows.

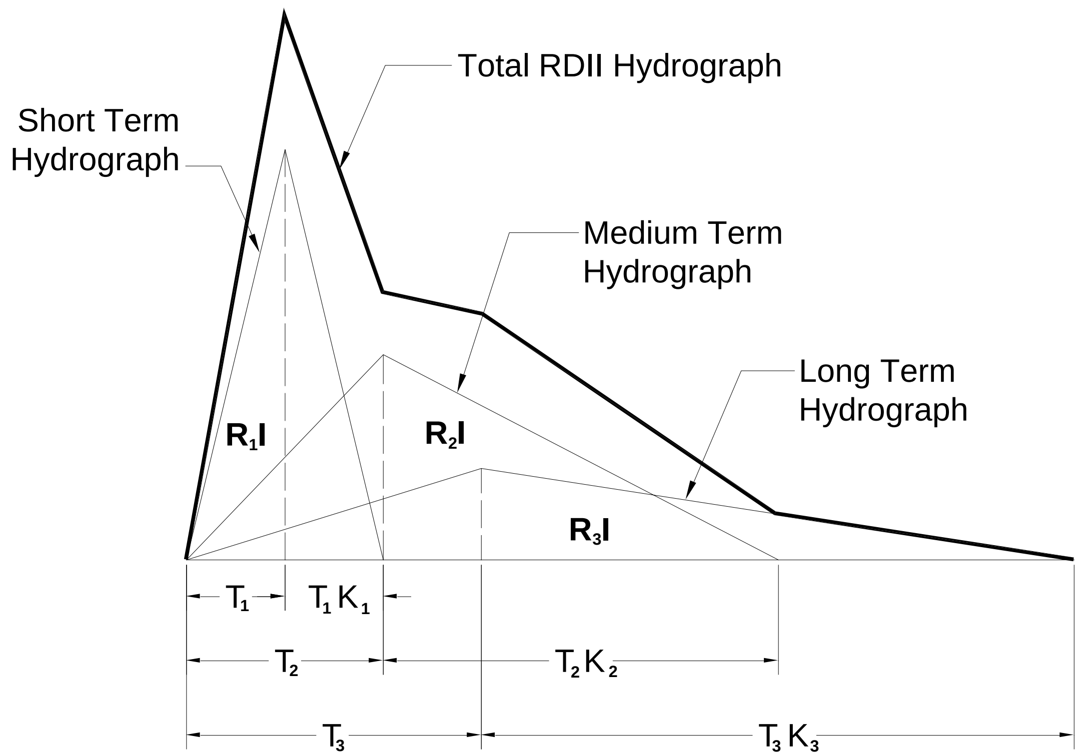



Figure 7 Example RDII Unit Hydrograph

### 5.2.2 Wet Weather Validation Results

The measured flows from January 6-12, 2017 were compared to the simulated dry weather (high occupancy) flows in the model. The measured flows leading up to the January 8, 2017 rainfall event were typically lower than the high occupancy model simulated flows. Because of this, the wastewater loads from the DWF scenario were scaled to match the base flows prior to the rainfall event. Scaling the base flows allows the entire I/I volume entering the collection system to be captured in the model. Without scaling the base flows, the I/I volume entering the system after the storm would be underestimated. This would also lead to the PWWFs in the evaluation scenarios being underestimated.

Comparisons were made for average and peak flows as well as the temporal distribution of flow until flows returned to their baseline levels. An example of the wet weather validation for Site A (Donner Lake Basin) is shown on Figure 8. Figure 8 shows the model simulated flow compared to the field measured flows during the major rainfall event as well as the recorded rainfall during the validation period. Wet weather validation plots for each of the flow monitoring areas are provided in Appendix B.

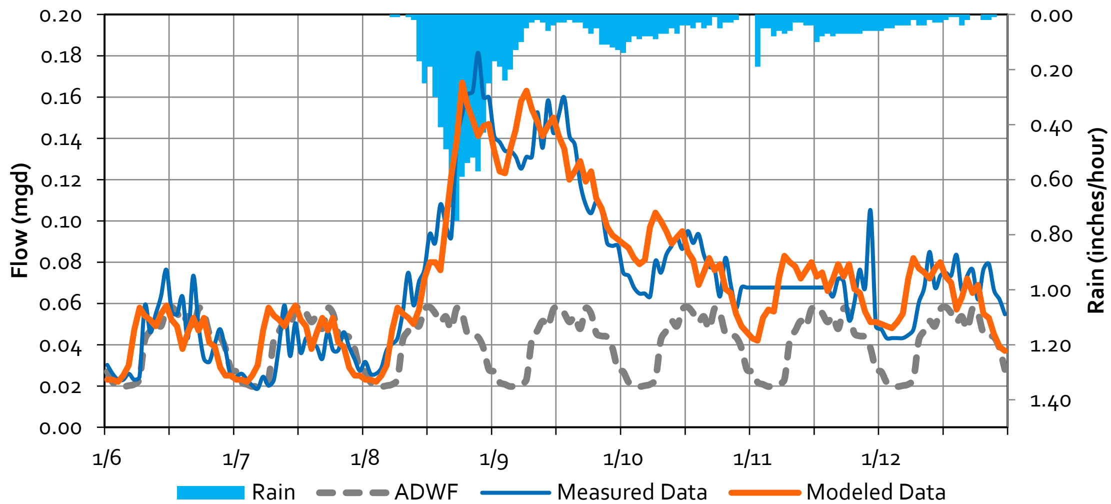



Figure 8 Wet Weather Verification Meter Site A (Donner Lake Basin)

Section 6

# SYSTEM EVALUATION

This section summarizes the performance criteria and the results of the existing and build-out system evaluations.

## 6.1 Performance Criteria

The capacity of District's wastewater collection system was evaluated based on the performance criteria defined in this section. The performance criteria address the collection system capacity and maximum allowable depth of flow within a sewer.

### 6.1.1 Gravity Sewers

Gravity sewer pipe capacities are dependent on many factors. The factors include roughness of the pipe and the selected maximum allowable depth of flow. The following describes the factors that account for the determination of existing and future pipeline capacities in the District's collection system.

- **Manning Coefficient (n).** The manning coefficient 'n' is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the manning coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for system planning purposes. For this study, a manning "n" factor of 0.013 was assigned by the District to all existing sewer collection system lines in the hydraulic model.
- **Flow Depth Criteria (d/D).** The primary criterion used to identify capacity deficient sewers or to size new sewer improvements is the maximum flow depth to pipe diameter ratio (d/D). The d/D value is defined as the depth of flow (d) in a pipe during peak

(design) flow conditions divided by the pipe's diameter (D). Based on Carollo's experience, District staff input, and industry standards, the following criteria were used:

- Flow Depth for Existing Sewers. Maximum flow depth criteria for existing sanitary sewers are established based on a number of factors, including the acceptable risk tolerance of the utility, local standards and codes, and other factors. Using a conservative d/D ratio when evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Conversely, lenient flow depth criteria could increase the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable flow depth criteria should be established to be as cost effective as possible while at the same time reducing the risk of SSOs to the greatest extent possible.

  For the District, water levels (hydraulic grade line) were allowed to rise to within 3-feet of the manhole rim. A capacity deficient sewer (i.e., system bottleneck) raises the hydraulic grade line of upstream sewers, leading to backwater conditions. The greater the capacity deficiency, the higher water levels will surcharge upstream of the bottleneck pipeline (or pipelines). The hydraulic model is used to determine "backwater" pipelines in order to specify which specific pipelines are the actual root causes of the capacity deficiency. Capital projects are proposed to provide greater flow capacity for the deficient sewers, which eliminates the backwater conditions that cause surcharging.

- Flow Depth for New Sewers. When designing sewer pipelines, it is common practice to adopt variable flow depth criteria for various pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes, which may experience flow peaks greater than design flow or blockages from debris, paper, or rags. For new pipelines less than 12 inches in diameter the max d/D value is 0.5 or 50 percent of the pipeline depth. Pipelines 12- to 18-inches in diameter, the max d/D is 0.67, and for pipelines larger than 18 inches in diameter the maximum d/D value is 0.75.

### 6.1.2 Pump Stations and Force Mains

Industry standard practice is to require that sewage lift stations have sufficient capacity to pump the PWWF with the largest pump out of service (firm capacity).

Force main piping should be sized to provide a minimum velocity of 3 ft/s at the design flow rate of the lift station and no more than 8 ft/s.

## 6.2 Existing Gravity Collection System Evaluation

For the existing sewer collection system, the 25-year design storm was routed through the hydraulic model on top of the high occupancy ADWF. In accordance with the established flow depth criteria for existing sewers, pipelines where the maximum hydraulic grade line (HGL) encroached within 3-feet of the manhole rim under the 25-year design storm were identified.

It is important to understand that not all of the pipelines where the maximum HGL encroached within 3-feet of the manhole rim are necessarily capacity deficient. In some cases, a surcharged condition within a given pipeline segment is due to backwater effects created by a downstream bottleneck (i.e., upstream surcharging is caused by downstream pipeline deficiencies). For this reason, the hydraulic model was analyzed to identify the pipeline segments that are the cause of the surcharged conditions. Evaluation of the existing wastewater collection system showed a pump capacity deficiency in the Donner Lake Basin (Lift Station 1B), approximately 890 LF of capacity deficient sewers in the Tahoe Donner Basin, and 180 LF of capacity deficient sewers/five pump station deficiencies in the Martis Valley Basin. The existing deficiencies are discussed further in Section 7.1.

## 6.3 Build-Out Gravity Collection System Evaluation

The analysis of the build-out system was performed in a manner similar to the existing system analysis. The purpose of the build-out system evaluation is to verify that the existing system improvements were appropriately sized to convey build-out PWWFs, and to identify the locations of sewers that are adequately sized to convey existing PWWFs, but cannot convey future PWWFs.

Build-out deficiencies are shown on Figures 9 through 12. At build-out, a total of approximately 22,700 LF of capacity deficient sewers were identified.

## 6.4 Pump Station Evaluation

The District's four hydraulic models include 42 operational lift stations. The modeled lift stations were evaluated to determine if they have sufficient capacity to convey existing and build-out PWWFs. Lift Stations with an influent PWWF above the firm capacity were flagged as deficient. The following pump stations were flagged as deficient:

- Donner Lake Basin
  - Lift Station 1 (capacity deficiency caused surcharging upstream of wet well)
  - Lift Station 1B (capacity deficiency caused surcharging upstream of wet well)
  - Lift Station 2
  - Lift Station 3
  - Lift Station 4 (capacity deficiency caused surcharging upstream of wet well)
  - Lift Station 5 (capacity deficiency caused surcharging upstream of wet well)
  - Lift Station DSP 2
- Tahoe Donner Basin
  - Pine Forest Lift Station (capacity deficiency caused surcharging upstream of wet well)
- Glenshire Basin
  - No pump station capacity deficiencies noted
- Martis Valley
  - Lahonton 1
  - Lahonton 3
  - Lahonton 4
  - Lahonton 5
  - Northstar

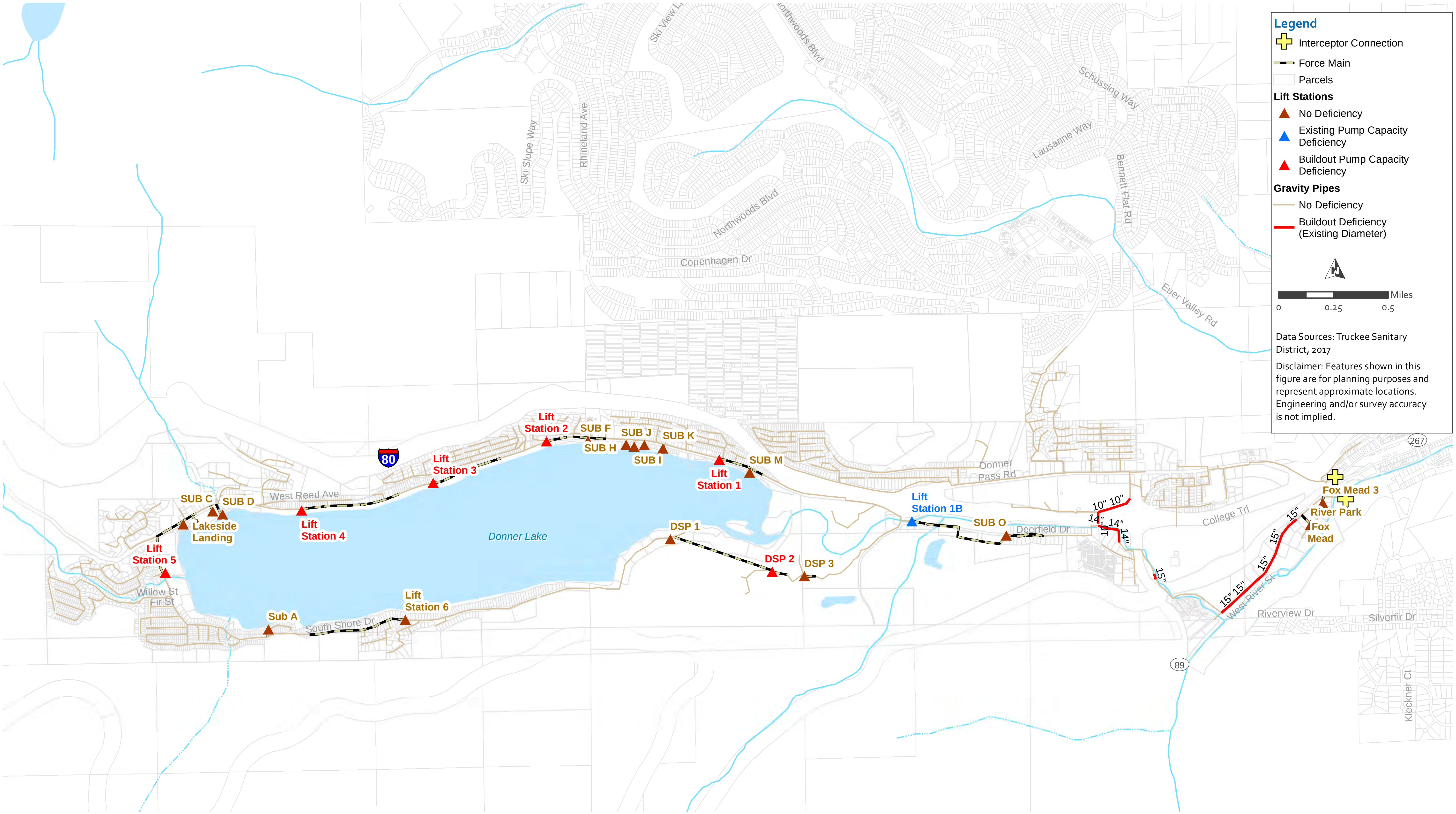



Figure 9
Donner Lake Deficiencies

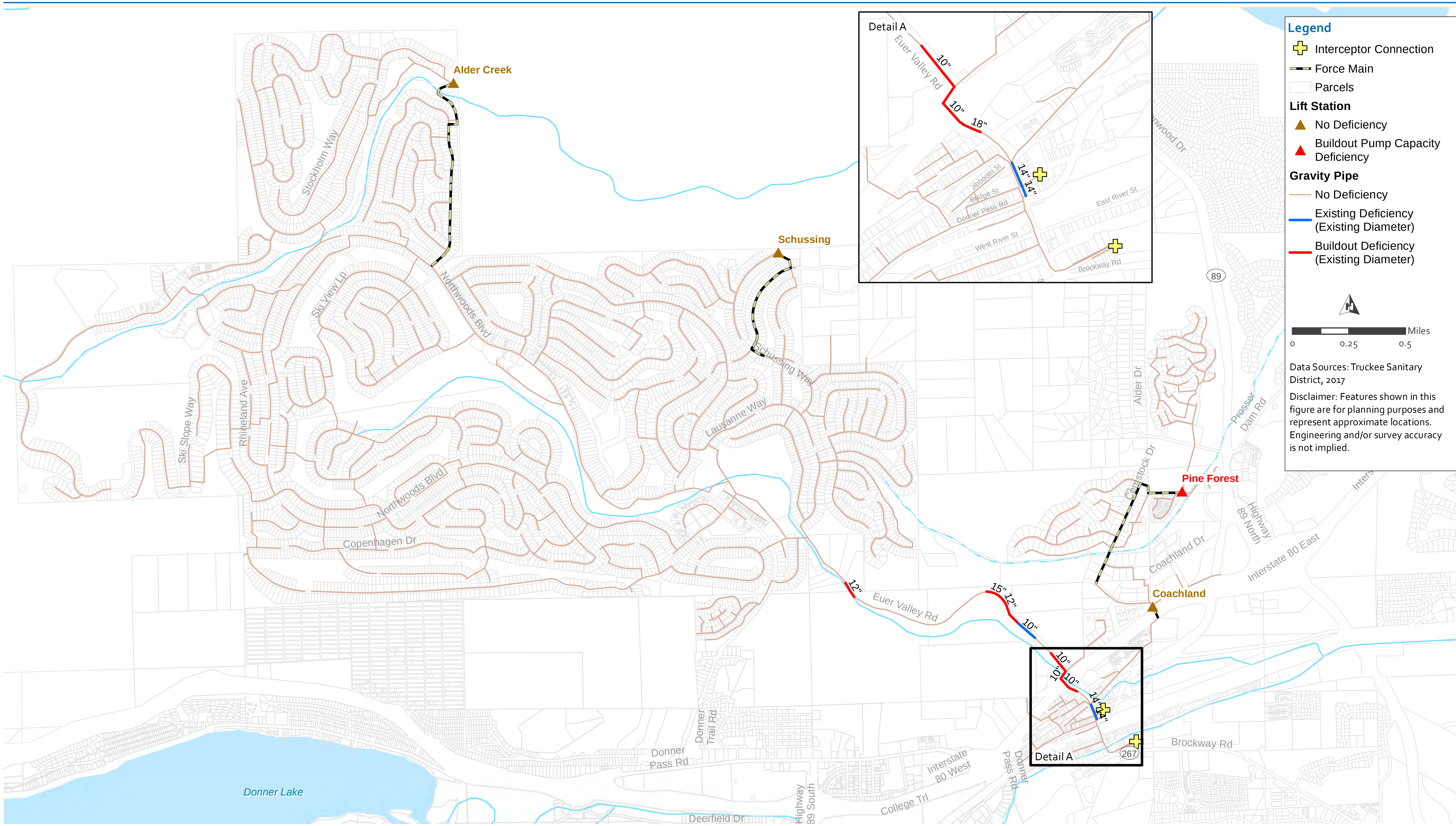



Figure 10
**Tahoe Donner Deficiencies**

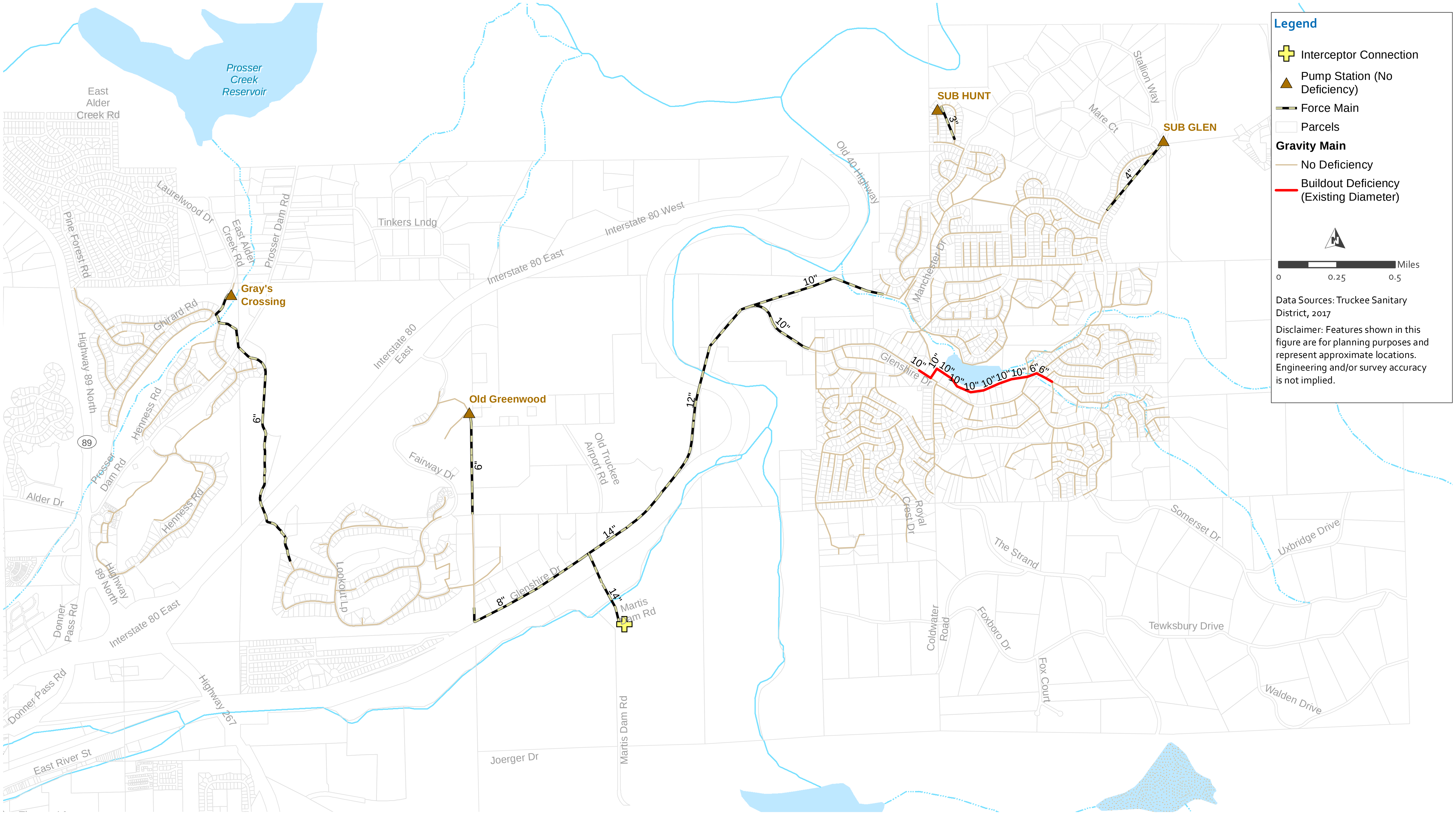



Figure 11
**Glenshire Deficiencies**

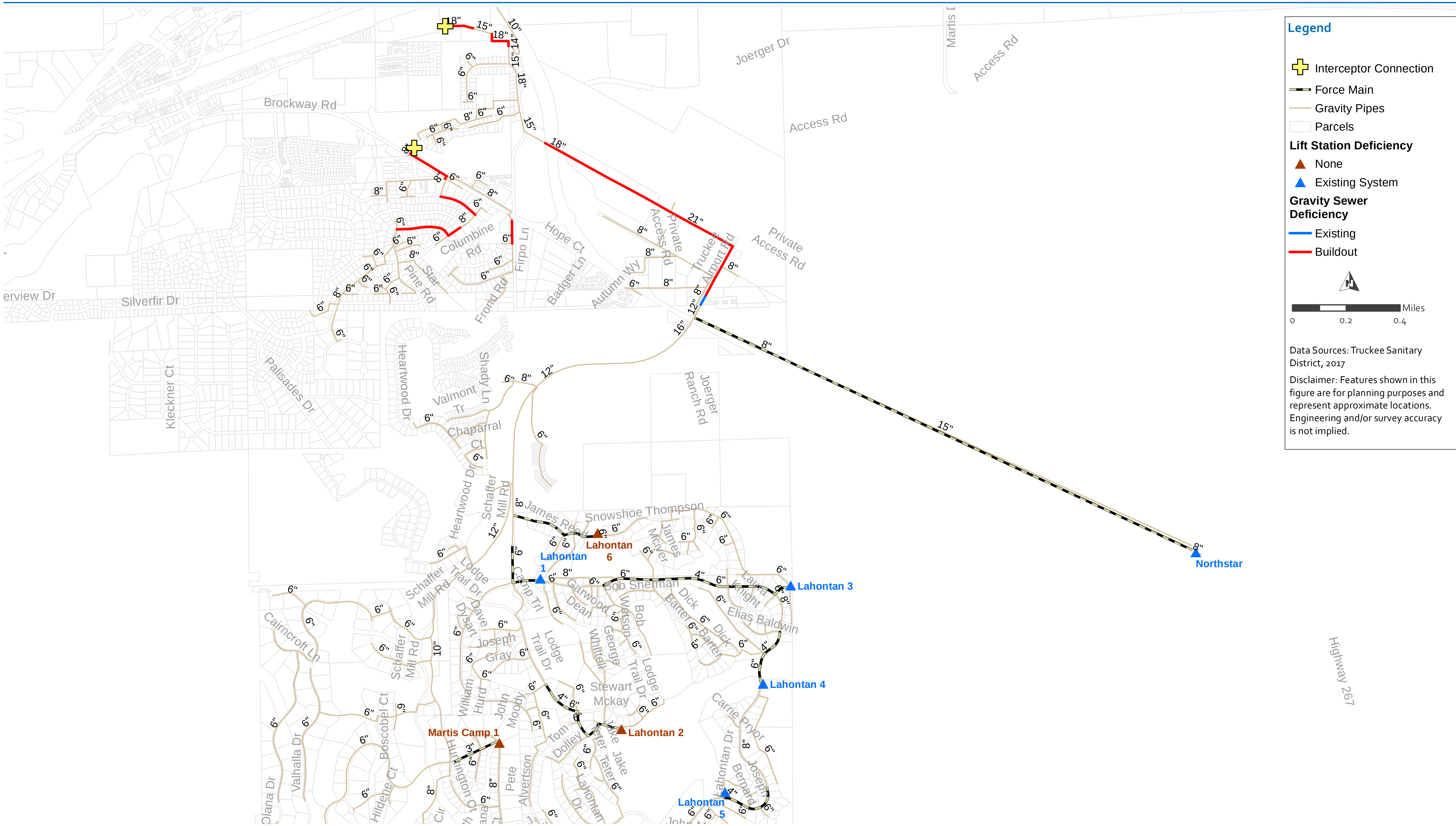



Figure 12
**Martis Valley Deficiencies**

Section 7

# RECOMMENDED IMPROVEMENTS

Figures 13 through 16 illustrates the proposed sewer improvements required to correct existing deficiencies and to serve future users. When an increase in capacity is required, existing sewers can be upgraded or a parallel or relief sewer can be constructed. For the purposes of this study, unless otherwise stated, we assumed that a capacity deficient sewer would be upgraded to a larger diameter. The upgraded pipeline generally followed the same slope as the existing pipeline, with the exception where survey data revealed negative or flat slopes in an existing alignment.

In essence, there are two alternatives for every trunk sewer project, but the decision to replace or construct a parallel sewer should be made during the preliminary design phase. During the preliminary design phase, the existing sewer should be inspected by closed circuit television (CCTV) to determine its structural condition. If severely deteriorated, the existing sewer should be upgraded. If moderately deteriorated, slip lining or cured-in-place pipe lining can rehabilitate the existing sewer.

The proposed improvements are sized for build-out conditions. As the District continues to grow, it is recommended that the proposed pipeline diameters be constructed so that the facilities have sufficient capacity for build-out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended due to the extended useful life of the improvements proposed herein. The proposed pipe diameter represents the ultimate diameter for build-out conditions.

## 7.1 Existing System Improvements

There are some areas of the existing wastewater collection system that do not have sufficient capacity to convey the current PWWF without exceeding the capacity criteria discussed in Section 6.1. The recommended improvements to correct existing deficiencies are summarized below:

- **Donner Lake Basin**
  - There are no existing gravity sewer or force main improvements recommended for the Donner Lake Basin
  - <u>Lift Station 1B Pump Replacement</u>. This project consists of upsizing the pump capacity at Lift Station 1B, which is exceeded under existing PWWF conditions.
- **Tahoe Donner Basin**
  - <u>Project TD-1</u>. This project consists of replacing approximately 370 LF of existing 14-inch diameter sewer along Bridge Street between Jibboom Street and Donner Pass Road with approximately 260 LF of 18-inch and 110 LF of 21-inch diameter sewer.

- Project TD-2. It is recommended that approximately 530 LF of 10-inch diameter sewer be replaced with a 12-inch diameter sewer. This project is located northwest of Bridge Street and Interstate 80 (I-80).
- There are no force main or pump station improvements recommended for the Tahoe Donner Basin

- **Glenshire Basin**
  - There are no existing gravity sewer, force main, or lift station improvements recommended for the Glenshire Basin
- **Martis Valley**
  - Project MV-1. It is recommended that approximately 180 LF of 12-inch diameter sewer be replaced with a new 18-inch diameter sewer. This project is located on Airport Road south of Soaring Way.
  - Pump Replacements. The following lift stations were flagged as capacity deficient under existing peak flow conditions. The recommended capacity upgrades identified below represent the ultimate required firm capacity at each lift station site.
    - Lahonton 1 – It is recommended that this lift station be upgraded to a firm capacity of 510 gallons per minute (gpm). The existing firm capacity of this lift station is approximately 340 gpm.
    - Lahonton 3 – It is recommended that this lift station be upgraded to a firm capacity of 280 gpm. The existing capacity of the list station is approximately 180 gpm.
    - Lahonton 4 – It is recommended that this lift station be upgraded to a firm capacity of 260 gpm. The existing capacity of the list station is approximately 170 gpm.
    - Lahonton 5 – It is recommended that this lift station be upgraded to a firm capacity of 240 gpm. The existing capacity of the list station is approximately 175 gpm.
    - Northstar – It is recommended that this lift station be upgraded to a firm capacity of 430 gpm. The existing capacity of the list station is approximately 225 gpm.

## 7.2 Build-Out System Improvements

The build-out collection system analysis identified areas of the collection system that cannot convey the build-out PWWF without exceeding the capacity criteria discussed in Section 6.1. The recommended improvements to correct future deficiencies are summarized below:

- **Donner Lake Basin**
  - Project DL-1. This project consists of replacing approximately 1,780 LF of existing 15-inch diameter sewer along West River Street west of River Park Place with a new 21-inch diameter sewer.

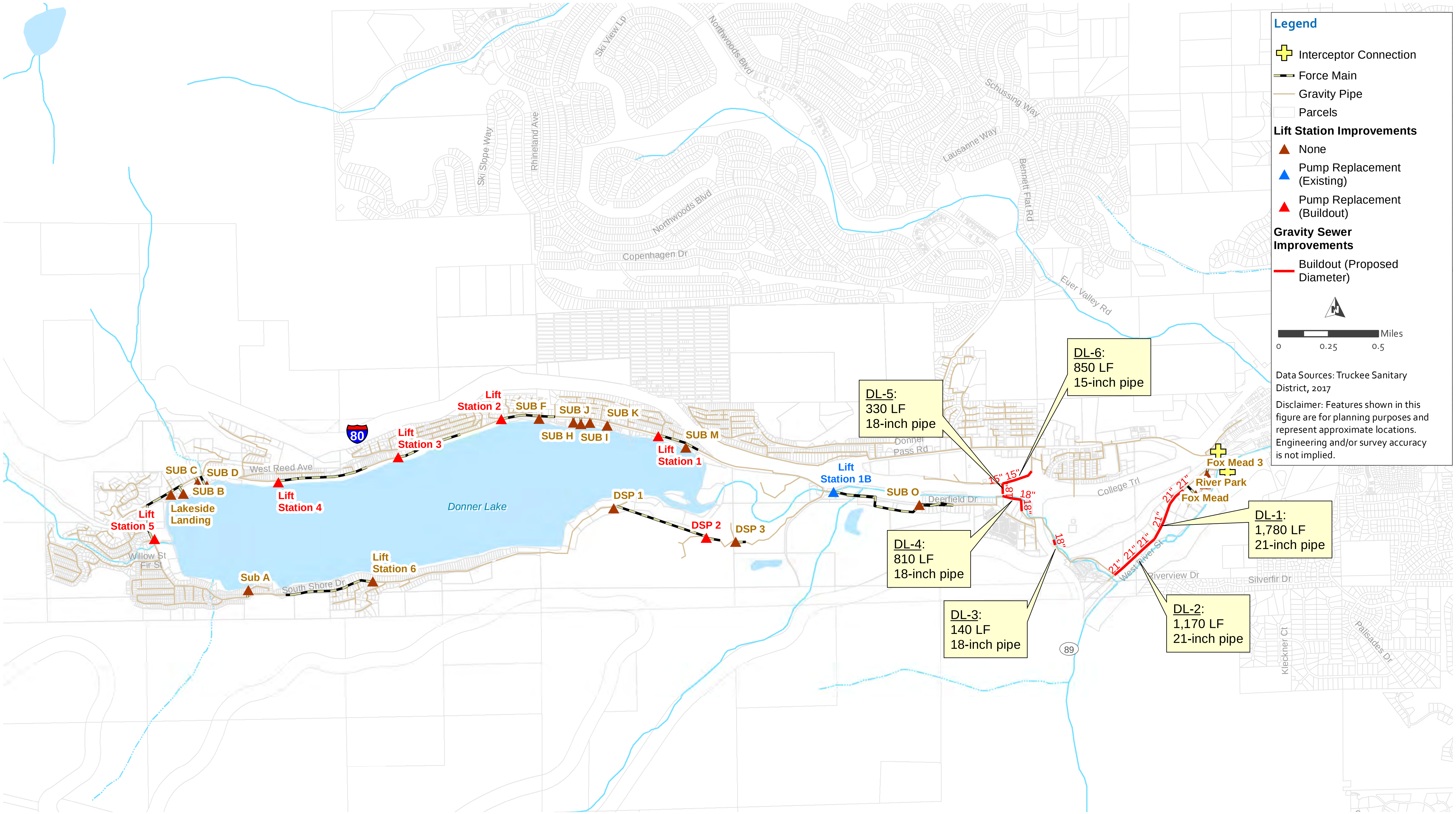



Figure 13
Donner Lake Improvements

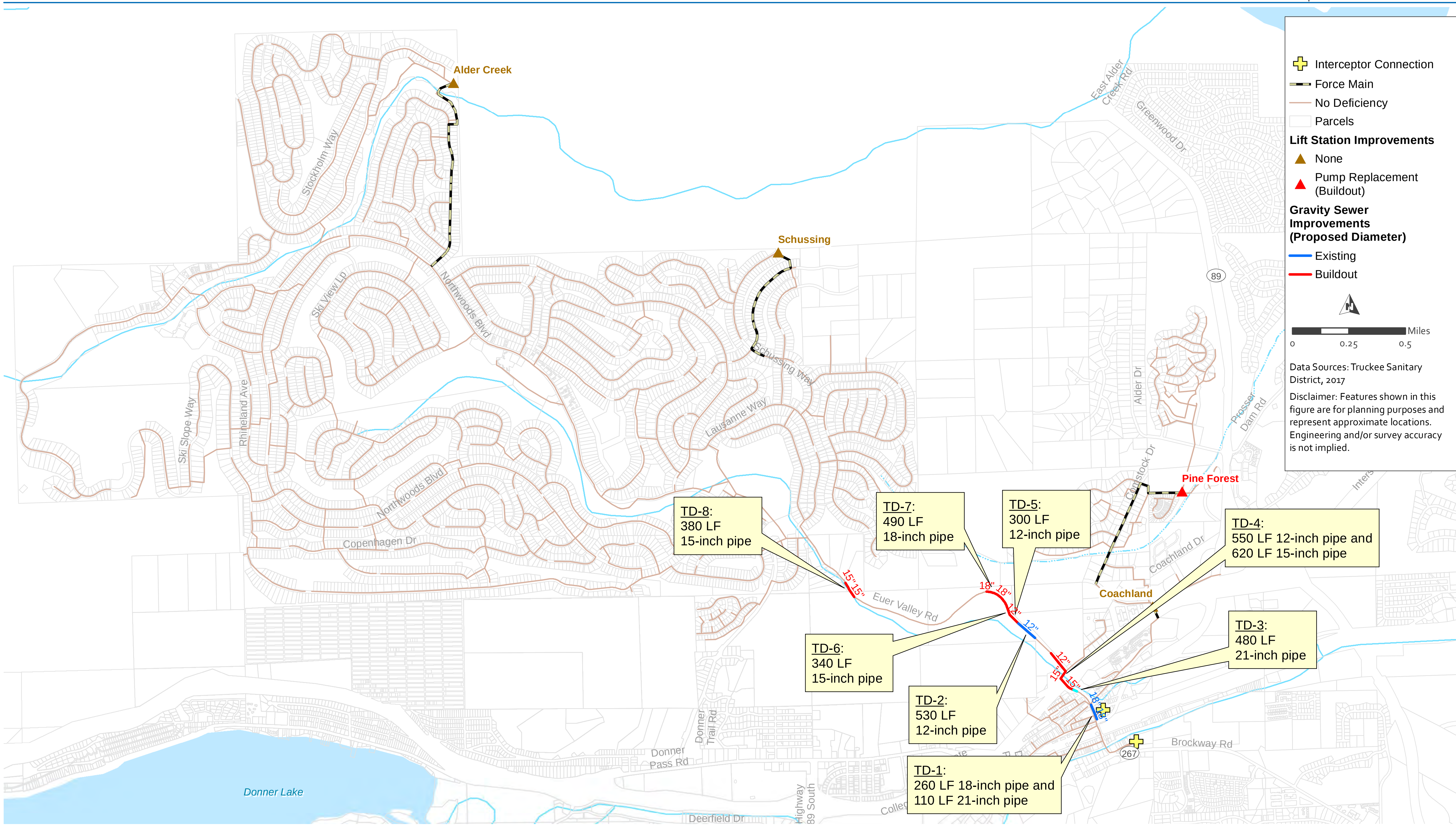
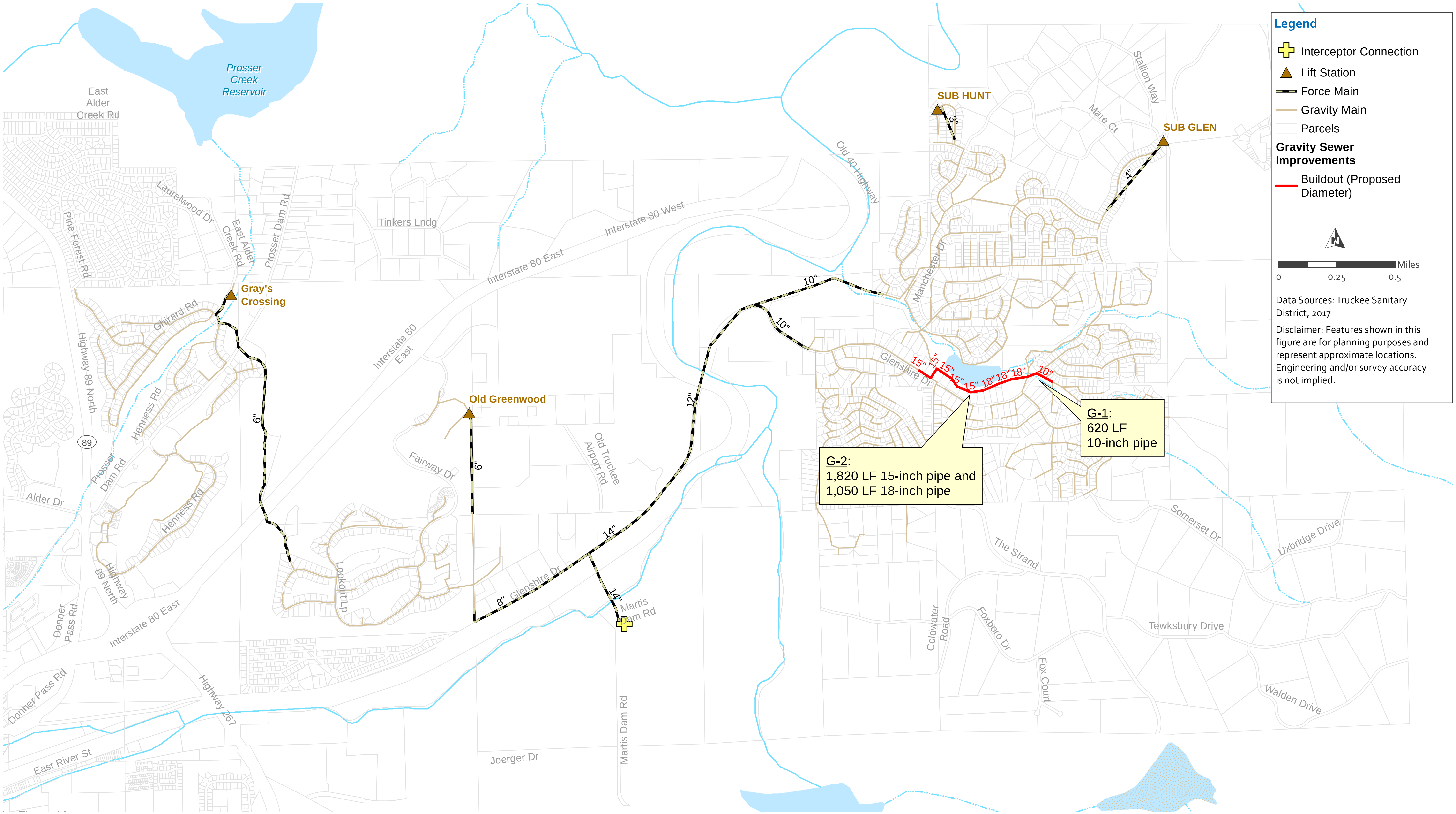



Figure 14
**Tahoe Donner Improvements**






Last Revised: March 19, 2018
pw://Carollo/Documents/Client/CA/Truckee SD/10635A00/Data/GIS/Figure 14.mxd

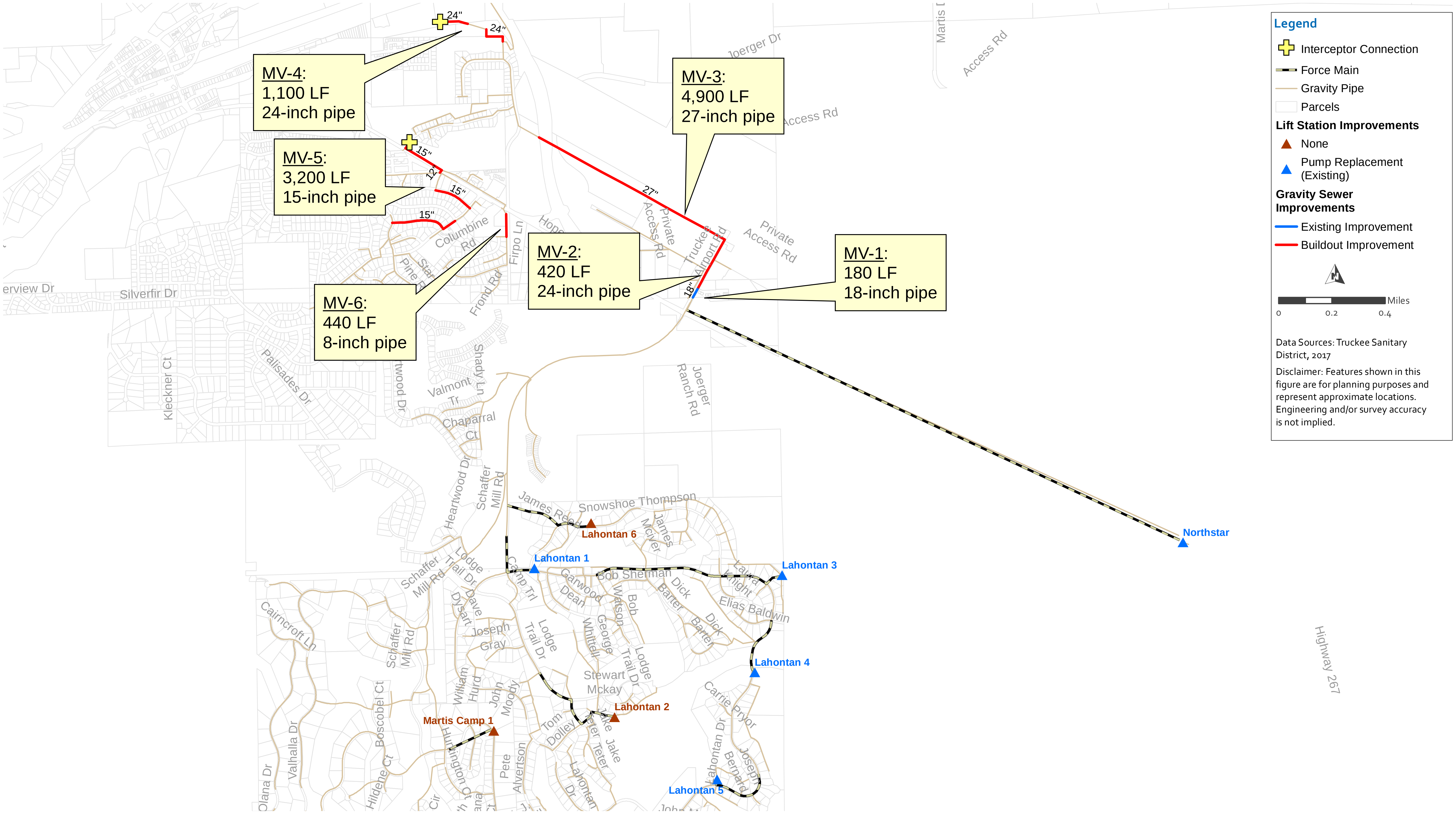



Figure 16
**Martis Valley Improvements**

- Project DL-2. It is recommended that approximately 1,170 LF of existing 15-inch diameter sewer be replaced with a 21-inch diameter sewer. This project extends along West River Street from 150' east of Donner Creek to 1,300 east of Donner Creek.
- Project DL-3**.** This project consists of replacing a short, 140 LF segment of existing 15-inch diameter sewer adjacent to Donner Creek, south of Deerfield Avenue with a new 18-inch diameter sewer.
- Project DL-4. It is recommended that approximately 810 LF of existing 14-inch diameter sewer be replaced with a new 18-inch diameter sewer. This project is located adjacent to Donner Creek, north of Deerfield Drive and South of I-80.
- Project DL-5. This project consists of replacing approximately 330 LF of existing 10-inch diameter sewer crossing Interstate 80 with a new 18-inch diameter sewer.
- Project DL-6. It is recommended that approximately 850 LF of existing 10-inch diameter sewer adjacent to Interstate 80 be replaced with a new 15-inch diameter sewer.
- Pump Replacements. The following lift stations were flagged as capacity deficient under build-out peak flow conditions. The recommended capacity upgrades identified below represent the ultimate required firm capacity at each lift station site.
  - Lift Station 1 – It is recommended that this lift station be upgraded to a firm capacity of 1,140 gallons per minute (gpm). The existing firm capacity of this lift station is approximately 960 gpm.
  - Lift Station 1B – It is recommended that this lift station be upgraded to a firm capacity of 1,470 gpm. The existing firm capacity of this lift station is approximately 1,020 gpm. This lift station was also found to be slightly capacity deficient under existing PWWF conditions (existing PWWF at this lift station is 1,070 gpm)
  - Lift Station 2 – It is recommended that this lift station be upgraded to a firm capacity of 970 gpm. The existing firm capacity of this lift station is approximately 820 gpm.
  - Lift Station 3 – It is recommended that this lift station be upgraded to a firm capacity of 910 gpm. The existing firm capacity of this lift station is approximately 790 gpm. It should be noted that the District has identified capacity constraints at this lift station in the past (notably during the January 2017 wet weather events). Because this lift station was not flagged as capacity deficient under existing PWWF conditions, it is recommended that the District install a flow meter upstream of this lift station (or on the discharge side of the pumps) to monitor flow at this site moving forward.

  - Lift Station 4 – It is recommended that this lift station be upgraded to a firm capacity of 880 gpm. The existing firm capacity of this lift station is approximately 710 gpm.
  - Lift Station 5 – It is recommended that this lift station be upgraded to a firm capacity of 670 gpm. The existing firm capacity of this lift station is approximately 620 gpm.
  - Lift Station DSP 2 – It is recommended that this lift station be upgraded to a firm capacity of 82 gpm. The existing firm capacity of this lift station is approximately 50 gpm.

- **Tahoe Donner Basin**
  - Project TD-3. This project consists of replacing approximately 480 LF of existing 18-inch diameter sewer on Bridge Street (south of I-80) with a new 21-inch diameter sewer.
  - Project TD-4. It is recommended that approximately 1,170 LF of 10-inch diameter sewer along Euer Valley Road and Bridge Street be replaced with approximately 554 LF of 12-inch and 615 LF of 15-inch diameter sewer.
  - Project TD-5. This project consists of replacing approximately 300 LF of 10-inch diameter sewer along Euer Valley Road with a new 12-inch diameter sewer.
  - Project TD-6. It is recommended that approximately 340 LF of 12-inch diameter gravity sewer along Euer Valley Road be replaced with a new 15-inch diameter sewer.
  - Project TD-7. This project consists of replacing approximately 490 LF of 15-inch diameter sewer along Euer Valley Road with a new 18-inch diameter sewer.
  - Project TD-8. It is recommended that approximately 380 LF of 12-inch diameter gravity sewer along Euer Valley Road (southeast of Lausanne Way) be replaced with a new 15-inch diameter sewer.
  - Pine Forest Lift Station Pump Replacement. This project consists of replacing the existing pumps at the Pine Forest Lift Station. The existing pumps do not have a sufficient total dynamic head to convey the build-out PWWF of 410 gpm. It is recommended that two new 410 gpm pumps be installed, with a total dynamic head of approximately 150-feet (exact design point should be further evaluated during preliminary design of this project).

- **Glenshire Basin**
  - Project G-1. This project consists of replacing approximately 620 LF of 6-inch diameter sewer near the corner of Glenshire Drive and Wellington Way with a new 10-inch diameter sewer.
  - Project G-2. It is recommended that approximately 2,870 LF of 10-inch diameter sewer along Glenshire Drive (between Wellington Way and Berkshire Circle) be replaced with approximately 1,820 LF of 15-inch and 1,050 LF of 18-inch diameter sewer.

- **Martis Valley**
  - Project MV-2. It is recommended that approximately 420 LF of 18-inch diameter sewer be replaced with a new 24-inch diameter. This project is located on Airport Road south of Soaring Way.
  - Project MV-3. It is recommended that approximately 4,900 LF of 18-inch/21-inch diameter sewer be replaced with a new 24-inch diameter. This project is located on Airport Road and Chandelle Way.
  - Project MV-4. It is recommended that approximately 1,100 LF of 18-inch/21-inch diameter sewer be replaced with a new 24-inch diameter. This project is located north of Martis Drive west of Highway 267.
  - Project MV-5. It is recommended that approximately 3,200 LF of 8-inch diameter sewer be replaced with a 15-inch diameter sewer. This project is located near Brockway Road.
  - Project MV-6. It is recommended that approximately 440 LF of 6-inch diameter sewer be replaced with a new 8-inch diameter sewer. This project is located on south of Brockway Road east of Columbine Road.

## Section 8

# TRIGGER ANALYSIS

The District is interested in understanding the general timeframe in which the proposed build-out system improvements would be required. Due to the uncertain nature of predicting future development patterns in the District's service area, a reasonable approach for the District is to develop an estimate of the remaining capacity in the system before a specific project would be triggered. For each of the proposed build-out system improvements, the District's hydraulic models were used to determine the amount of additional flow that can be conveyed through the existing infrastructure (i.e., sewer mains and pump stations) before a deficiency would be triggered (i.e., before the water level in manholes encroach within three feet of the manhole rim or when pump station firm capacity is exceeded). This value equates to the additional available existing peak flow capacity of each future system improvement. This peak flow capacity was divided by the future PWWF peaking factor (cited in Table 5) to obtain the existing available average day flow. The additional available average flow capacity was then divided by the District's standard flow per equivalent dwelling unit (EDU) value of 230 gallons per day/EDU (gpd/EDU) to determine an approximate number of EDU's that would trigger the capacity deficiency. The additional available capacity for each build-out system improvement is summarized in Table 6 for reference.

Table 6 Additional Available Flow Capacity for Build-Out System Improvements

| Improvement ID | Estimated Remaining Peak Capacity (gpm) | Future Peaking Factor(1) | Estimated Remaining Average Capacity (gpm) | Remaining EDUs (2) |
|---|---|---|---|---|
| **Donner Lake** | | | | |
| DL-1 | 550 | 3.08 | 179 | 1,118 |
| DL-2 | 40 | 3.08 | 13 | 81 |
| DL-3 | 95 | 3.08 | 31 | 193 |
| DL-4 | 100 | 3.08 | 32 | 203 |
| DL-5 | 100 | 3.08 | 32 | 203 |
| DL-6 | 100 | 3.08 | 32 | 203 |
| LS 1 | 71 | 3.08 | 23 | 145 |
| LS 1B | 0 | 3.08 | 0 | 0 |
| LS 2 | 167 | 3.08 | 54 | 340 |
| LS 3 | 184 | 3.08 | 60 | 375 |
| LS 4 | 227 | 3.08 | 74 | 461 |
| LS 5 | 234 | 3.08 | 76 | 475 |
| LS DSP 2 | 8 | 3.08 | 3 | 17 |
| **Tahoe Donner** | | | | |
| TD-3 | 21 | 2.59 | 8 | 51 |
| TD-4 | 201 | 2.59 | 78 | 486 |
| TD-5 | 345 | 2.59 | 133 | 834 |
| TD-6 | 345 | 2.59 | 133 | 834 |
| TD-7 | 345 | 2.59 | 133 | 834 |
| TD-8 | 140 | 2.59 | 54 | 338 |
| Pine Forest LS | 215 | 2.59 | 83 | 520 |
| **Glenshire** | | | | |
| G-1 | 220 | 2.42 | 91 | 569 |
| G-2 | 178 | 2.42 | 74 | 461 |
| **Martis Valley** | | | | |
| MV-2 | 195 | 3.55 | 55 | 344 |
| MV-3 | 195 | 3.55 | 55 | 344 |
| MV-4 | 780 | 3.55 | 220 | 1,376 |
| MV-5 | 240 | 3.55 | 68 | 423 |
| MV-6 | 95 | 3.55 | 27 | 168 |

Notes:
(1) See Table 5 for future PWWF peaking factors
(2) Based on District standard of 230 gpd/EDU

Section 9

# CONCLUSIONS

The District's wastewater collection system is separated into four major basins: Martis Valley, Donner Lake, Tahoe Donner, and Glenshire. The District has developed four separate hydraulic models (one for each basin). As part of this project, all four hydraulic models were updated and validated. Wet weather flow parameters were input in order to simulate a design storm condition under high occupancy conditions for existing and build-out flows.

Several recommendations were developed for the District's future hydraulic modeling program, as described below:

- Consider upgrading the District's InfoSewer models into a newer software platform, such as InfoSWMM.
- Verify accuracy of the District's existing flowmeter data.
- Perform field pump tests and update pump curves in the model, especially for lift stations with outdated pump information.
- Maintain a database where differences in pump operation, maintenance, and controls during dry and wet weather are recorded and updated over time.

A capacity analysis of the Donner Lake, Tahoe Donner, Martis Valley, and Glenshire basins was performed as part of this study. As part of the existing system analysis, some areas of the District's collection system do not have sufficient capacity to convey a 25-year design storm under existing high occupancy conditions. The existing system analysis showed one pump capacity deficiency in the Donner Lake Basin (Lift Station 1B), approximately 890 LF of capacity deficient sewers in the Tahoe Donner Basin, and 180 LF of capacity deficient sewers/five pump station deficiencies in the Martis Valley basin. At build-out, a total of approximately 22,700 LF of capacity deficient sewers and seven additional pump station capacity deficiencies were identified.

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Appendix A

# DRY WEATHER FLOW VALIDATION RESULTS

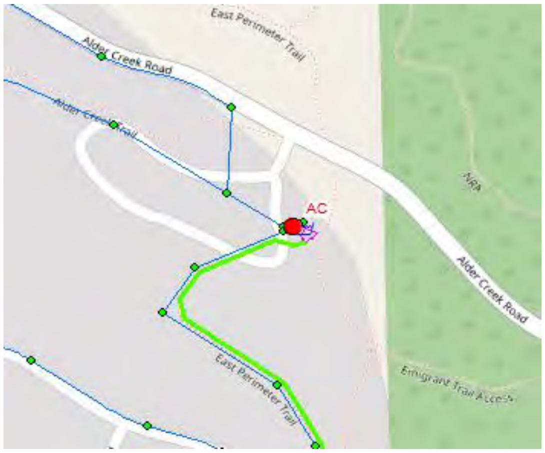
TRUCKEE SANITARY DISTRICT

## Flow Monitoring Site AC Dry Weather Flow Validation

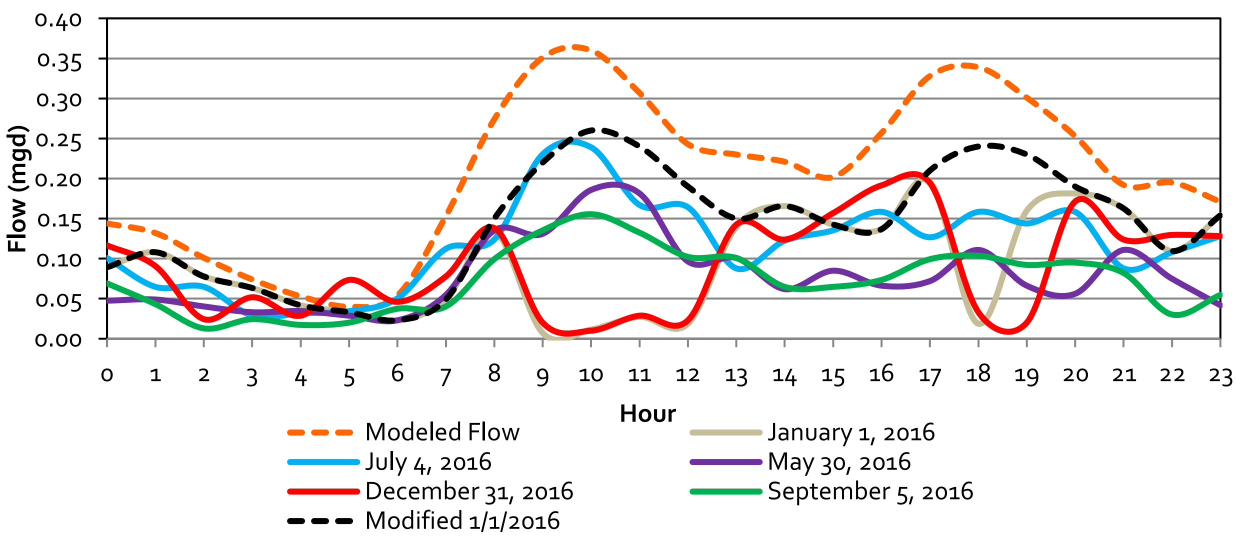
Location: Campground (13901 Alder Creek Road)

Pipeline diameter: 8"

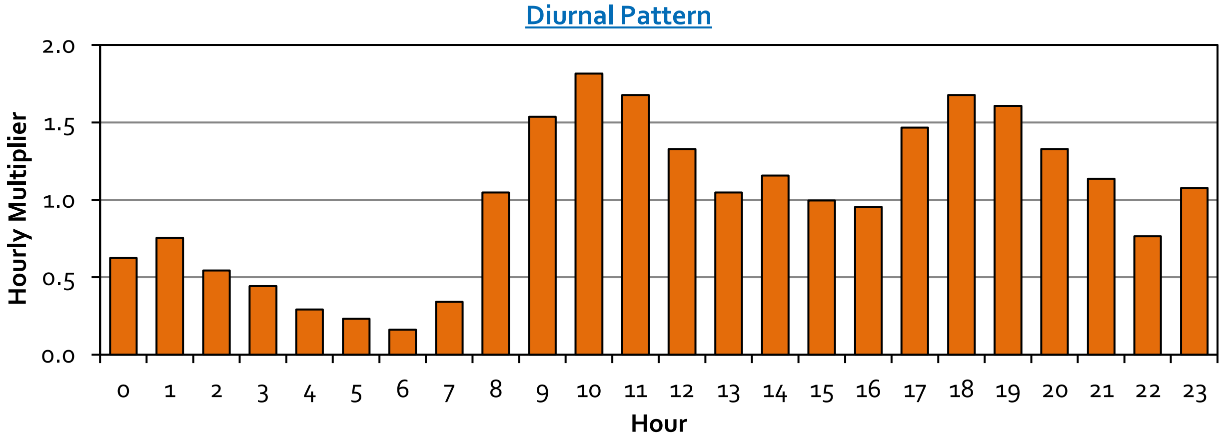
### Flow Monitor Location




### Flow Validation




### Diurnal Pattern



TRUCKEE SANITARY DISTRICT

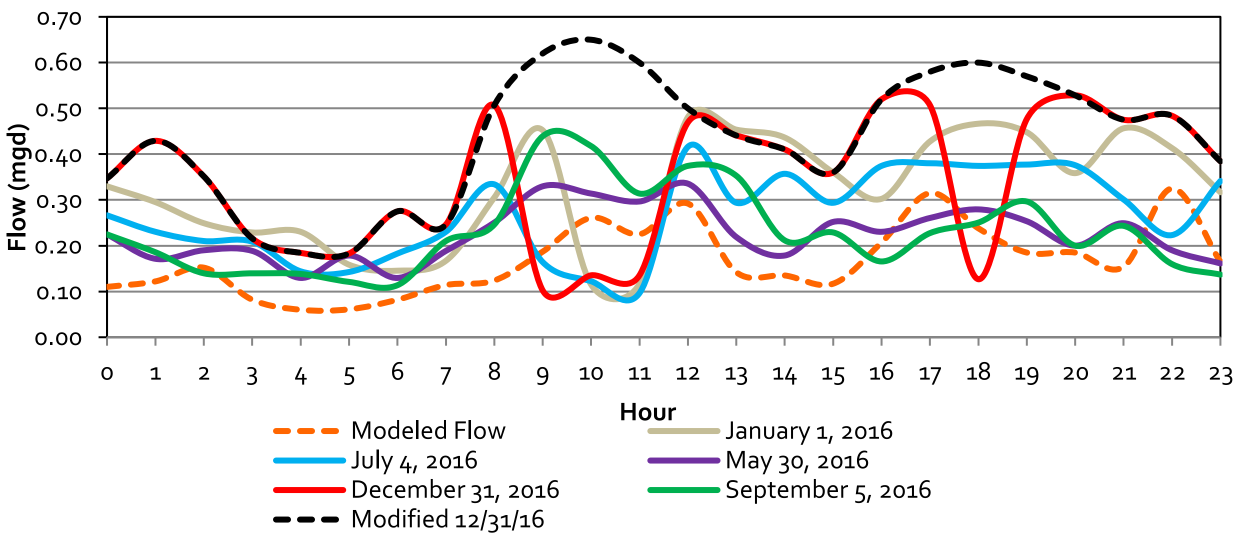
## Flow Monitoring Site BF Dry Weather Flow Validation

Location: East Euer Valley Road east of Lausanne Way

Pipeline diameter: 10"

### Flow Monitor Location


### Flow Validation

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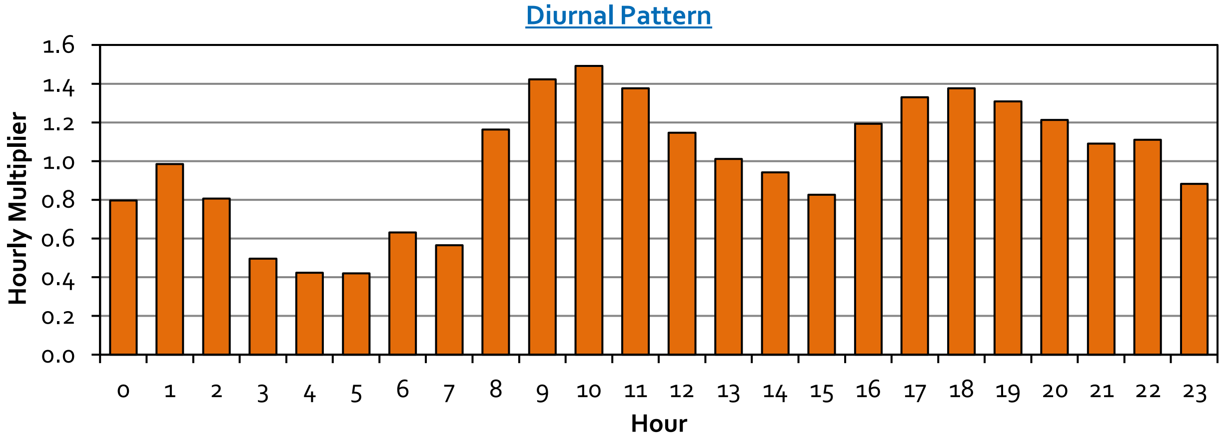


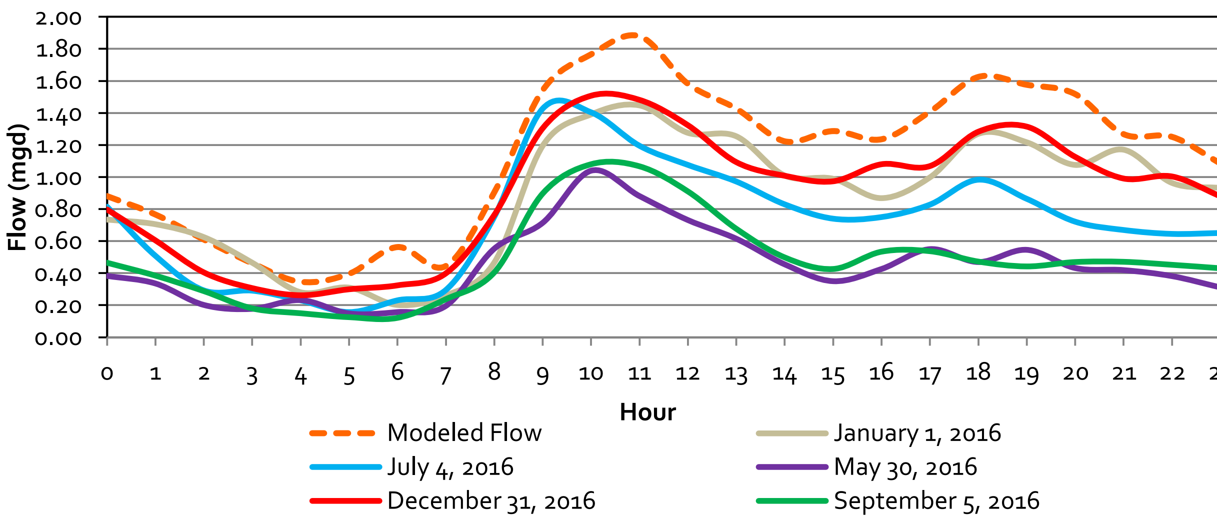
Flow Monitoring Site TC Dry Weather Flow Validation

Location: East Euer Valley Road east of Lausanne Way

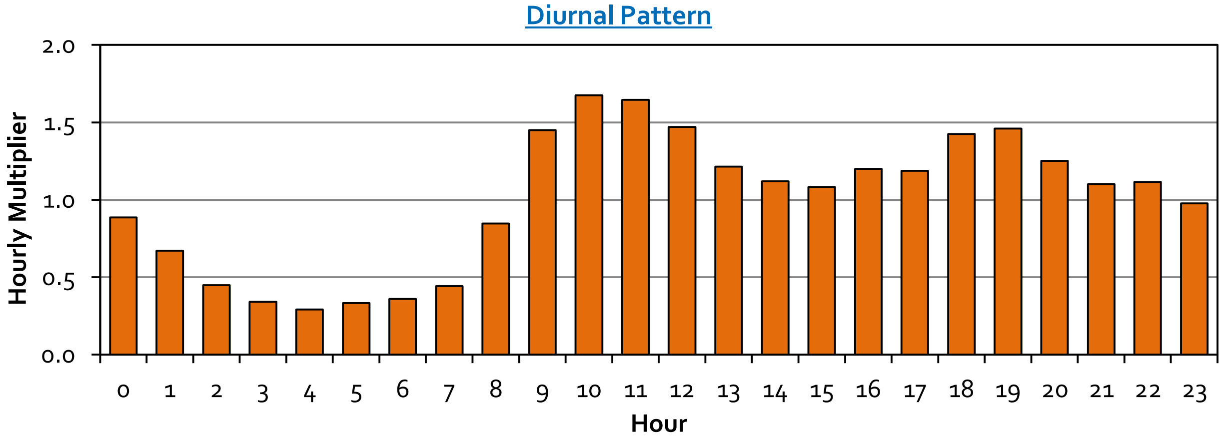
Pipeline diameter: 15"

Flow Monitor Location


Flow Validation




Diurnal Pattern



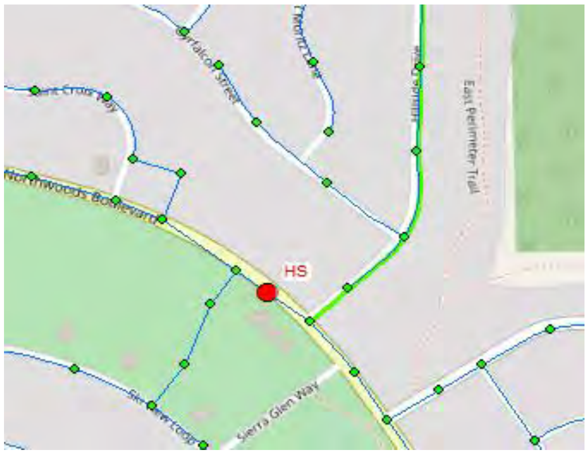
TRUCKEE SANITARY DISTRICT

## Flow Monitoring Site HS Dry Weather Flow Validation

Location: Northwoods Boulevard northwest of Hillside Drive

Pipeline diameter: 12"

### Flow Monitor Location

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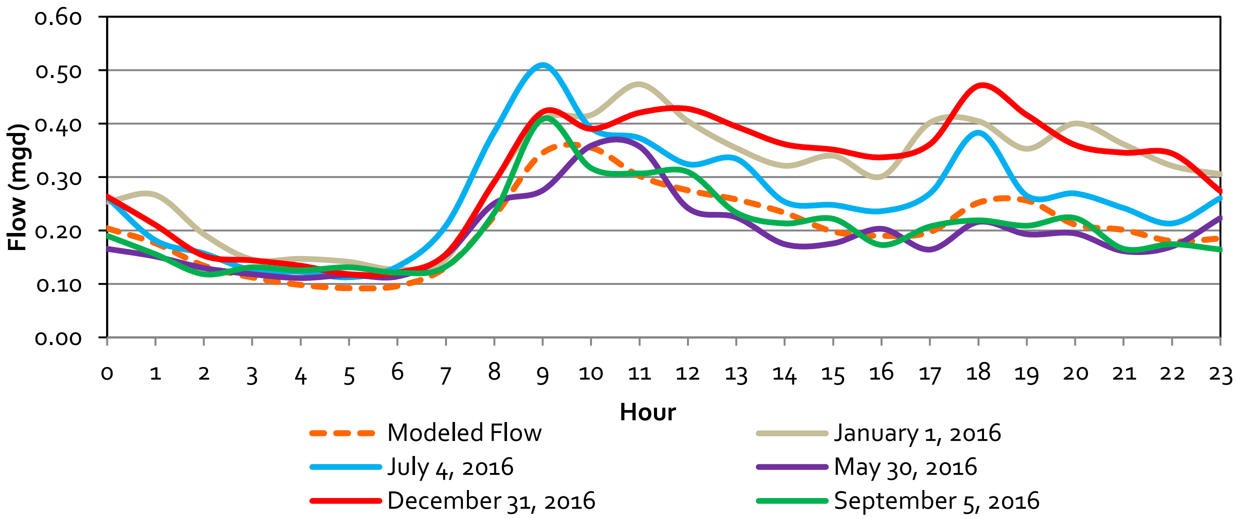
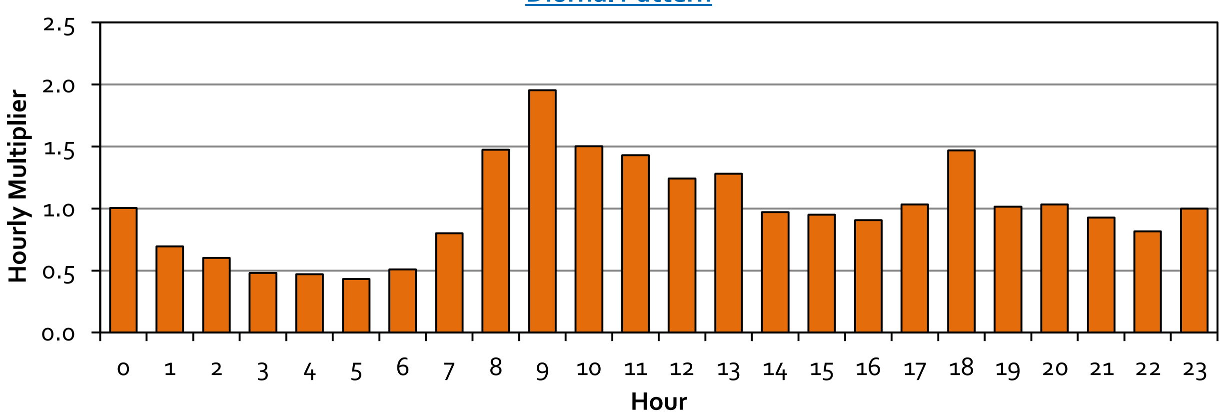



### Diurnal Pattern



TRUCKEE SANITARY DISTRICT

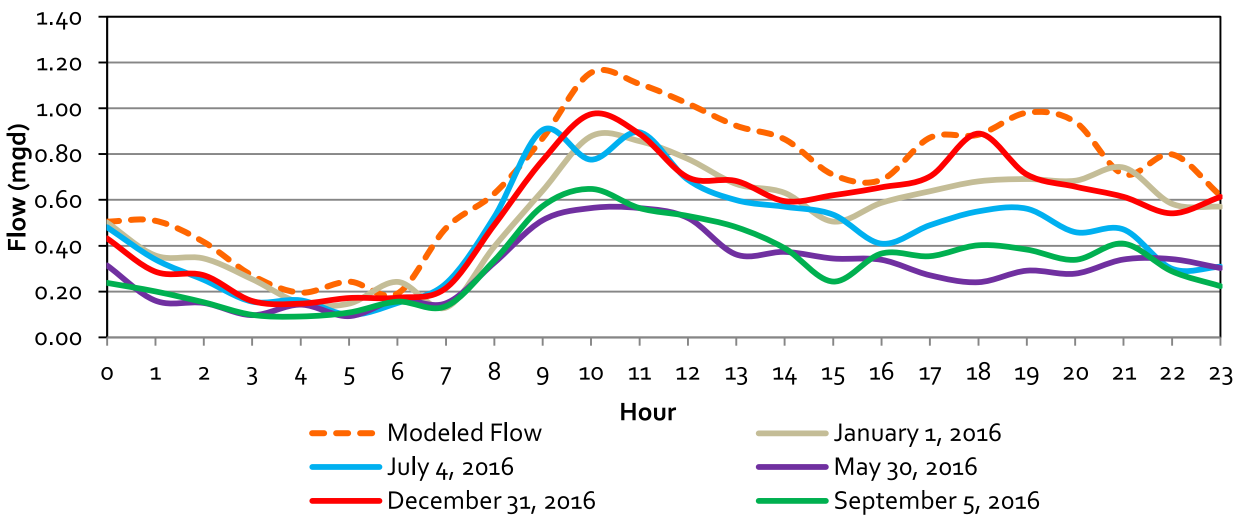
## Flow Monitoring Site TDL Dry Weather Flow Validation

Location: Northwoods Boulevard east of Hansel Avenue

Pipeline diameter: 12"

### Flow Monitor Location


### Flow Validation

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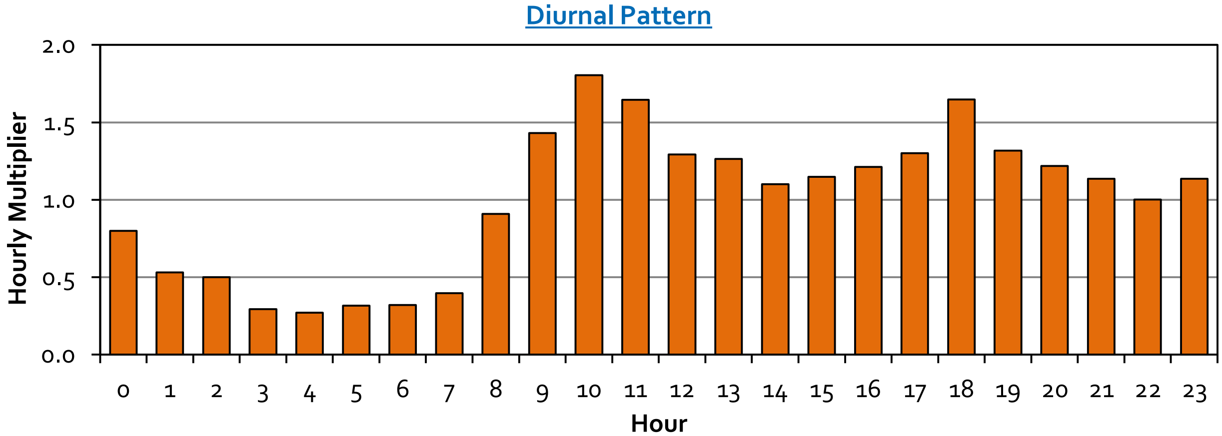


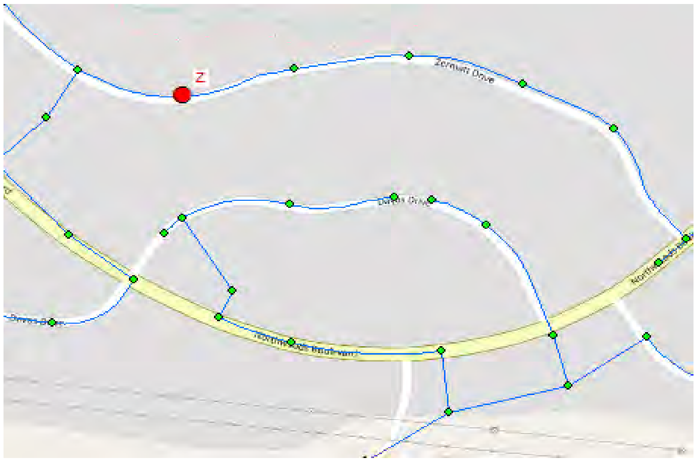
TRUCKEE SANITARY DISTRICT

## Flow Monitoring Site Z Dry Weather Flow Validation

Location: Zermatt Drive west of Northwoods Boulevard

Pipeline diameter: 12"

### Flow Monitor Location

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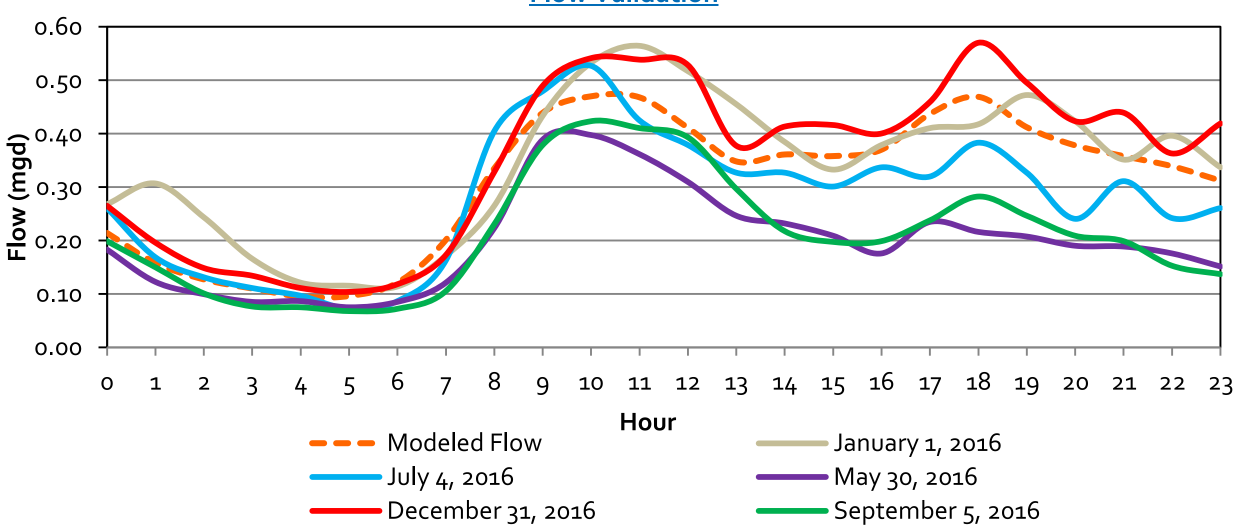


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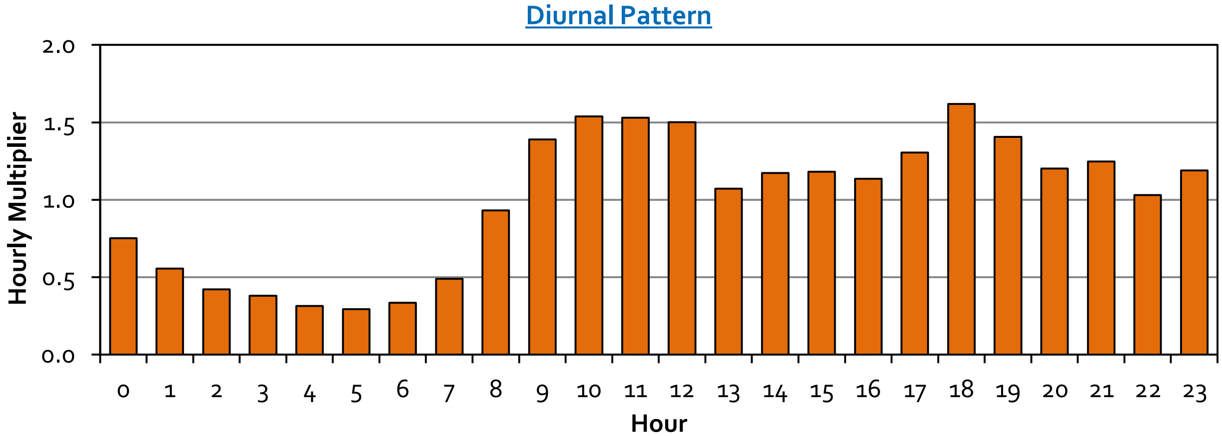


TRUCKEE SANITARY DISTRICT

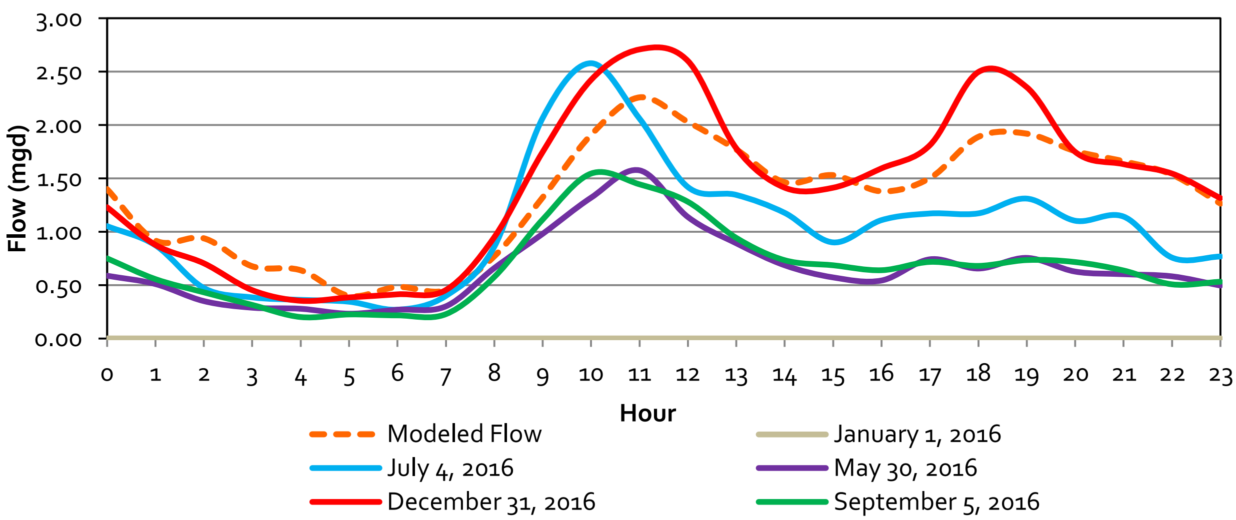
## Flow Monitoring Site D Dry Weather Flow Validation

Location: Bridge Street south of I-80

Pipeline diameter: 18"

### Flow Monitor Location


### Flow Validation

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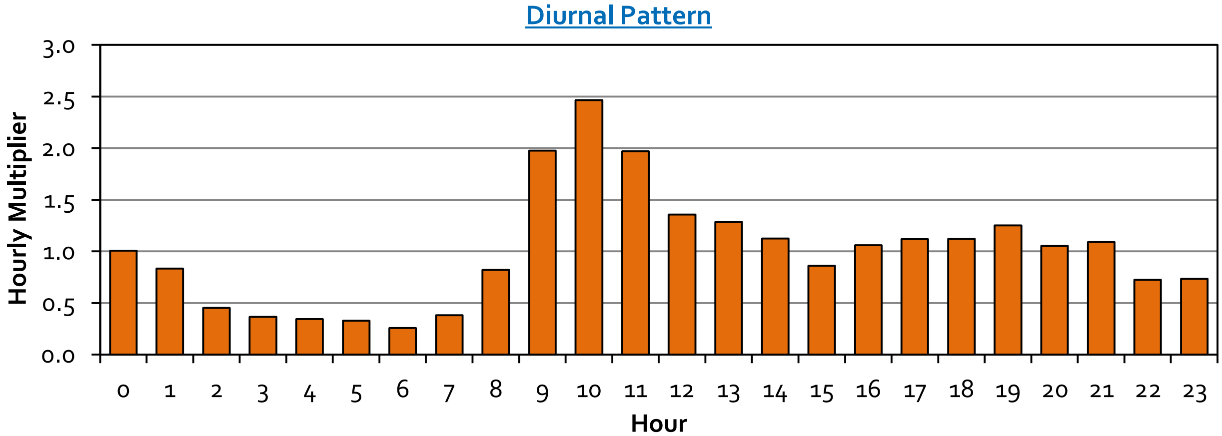


TRUCKEE SANITARY DISTRICT

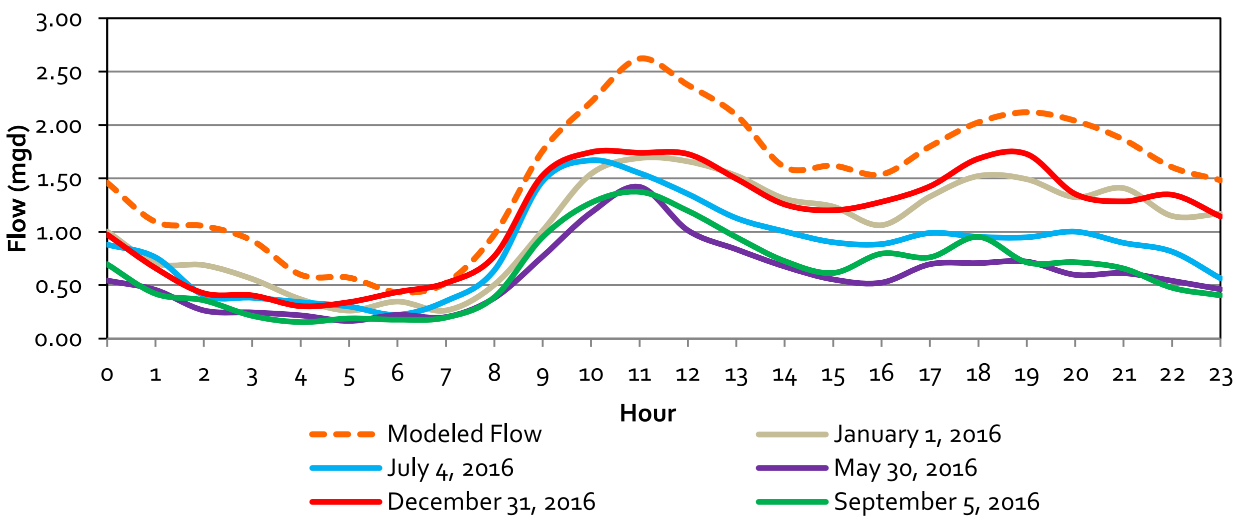
## Flow Monitoring Site E Dry Weather Flow Validation

Location: Bridge Street and Riverside Drive

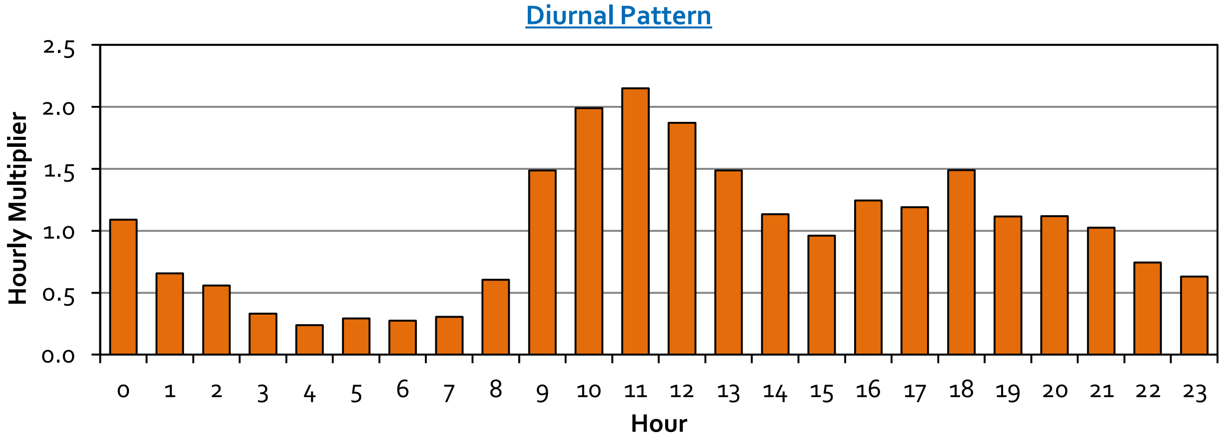
Pipeline diameter: 18"

### Flow Monitor Location


### Flow Validation




### Diurnal Pattern



TRUCKEE SANITARY DISTRICT

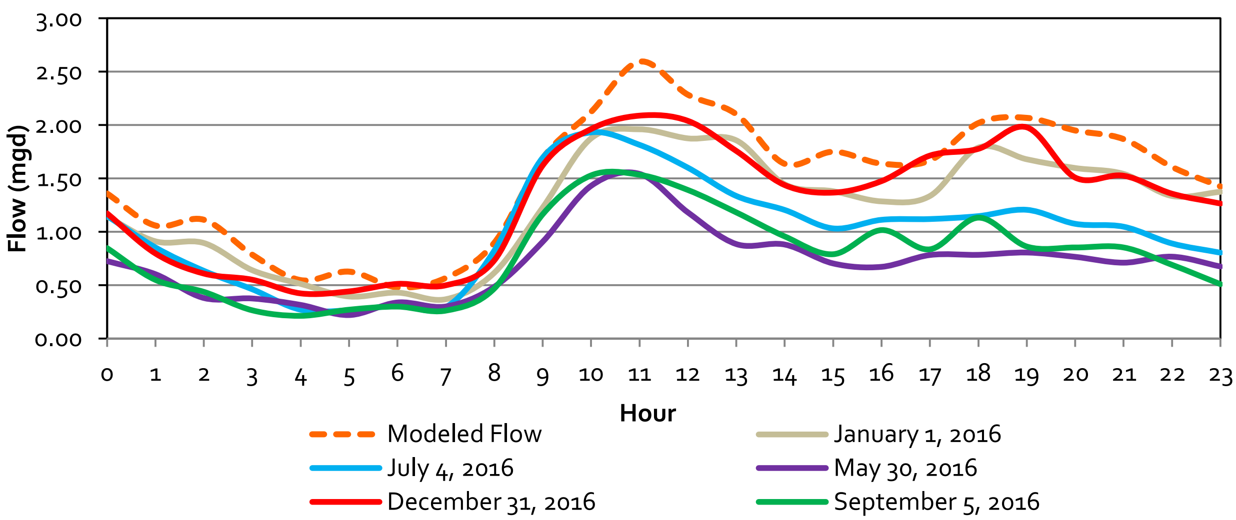
Flow Monitoring Site SE Dry Weather Flow Validation

Location: South East River Street east of Brockway Road

Pipeline diameter: 24"

## Flow Monitor Location


## Flow Validation

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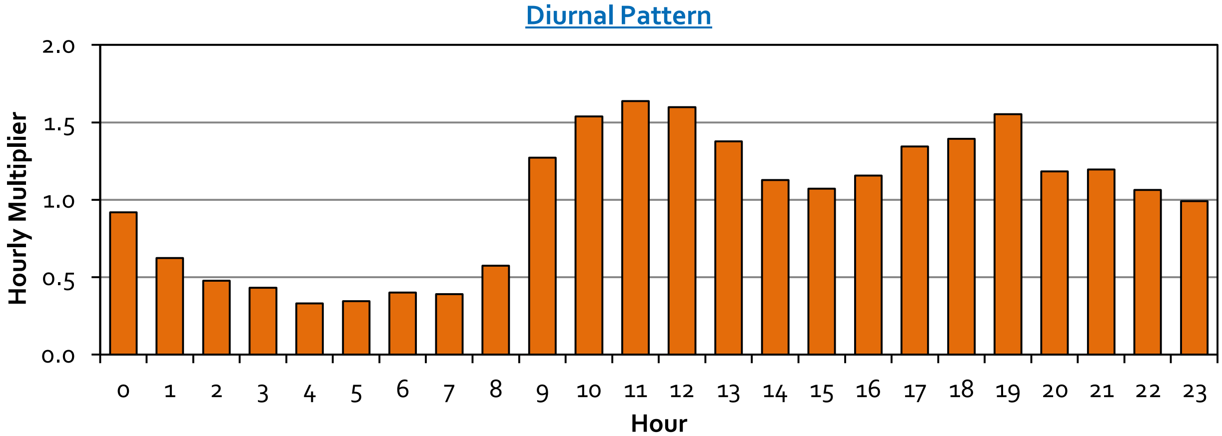


TRUCKEE SANITARY DISTRICT

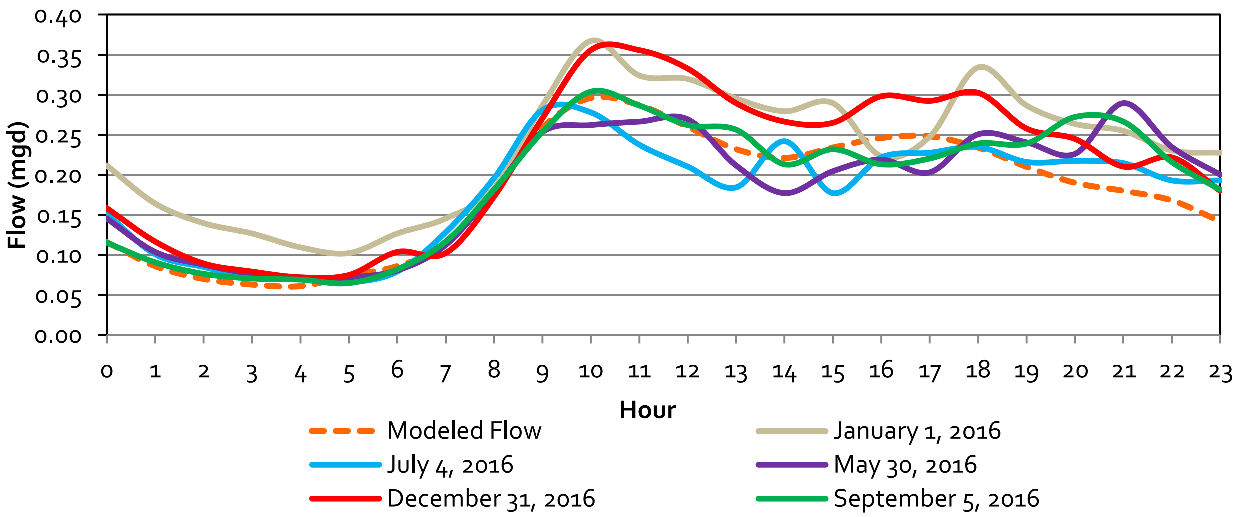
## Flow Monitoring Site GD Dry Weather Flow Validation

Location: Glenshire Drive and Light Hill Place

Pipeline diameter: 10"

### Flow Monitor Location


### Flow Validation

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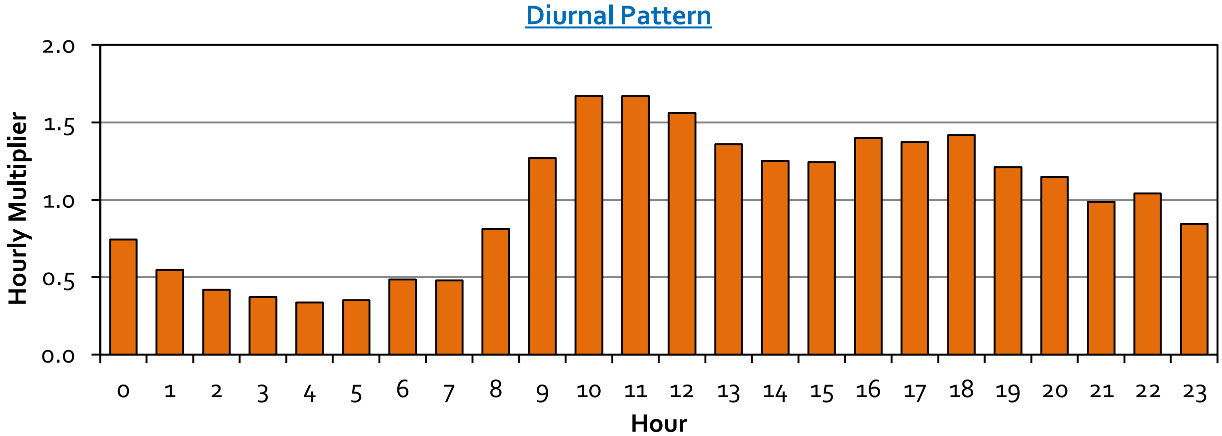


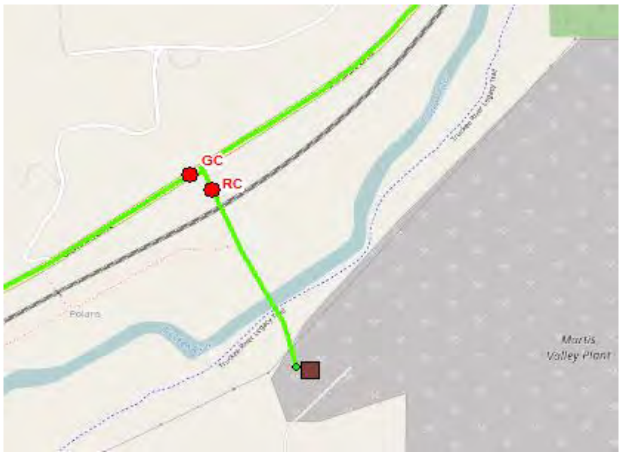
TRUCKEE SANITARY DISTRICT

Flow Monitoring Site GC Dry Weather Flow Validation

Location: Glenshire Drive west of Overland Trail

Pipeline diameter: 8"

Flow Monitor Location

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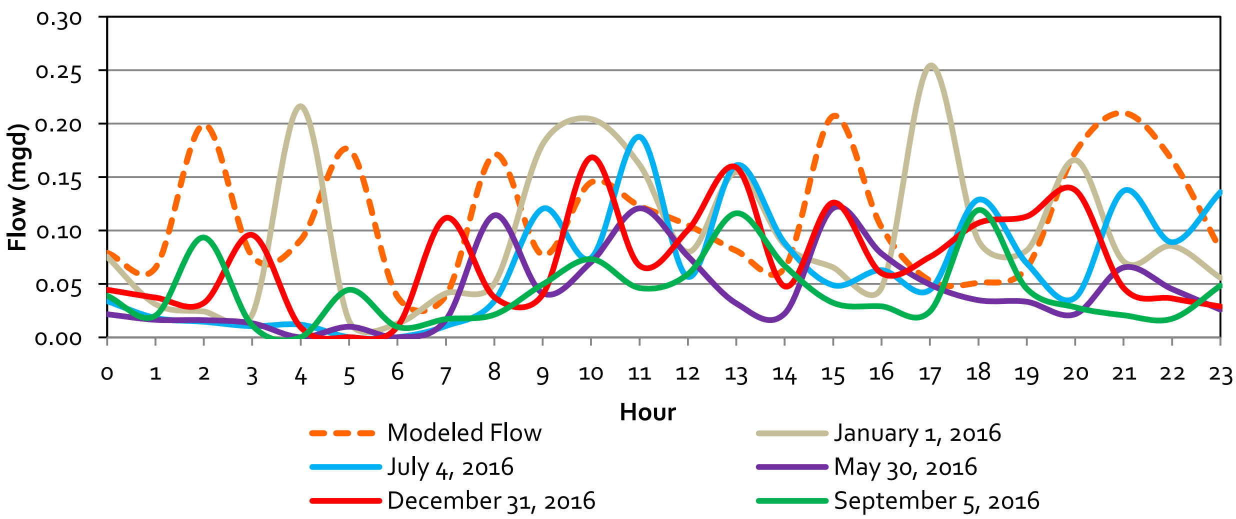


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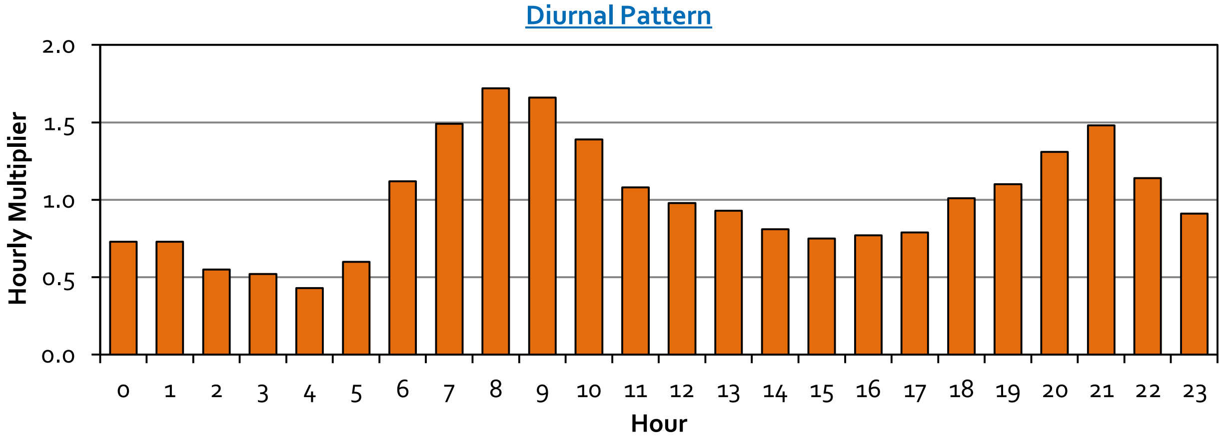


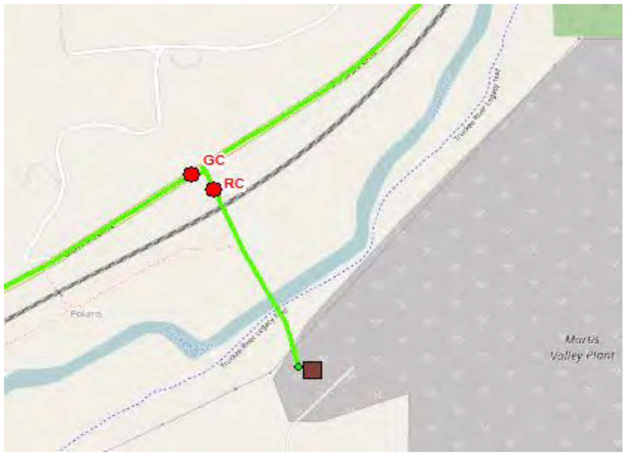
TRUCKEE SANITARY DISTRICT

Flow Monitoring Site RC Dry Weather Flow Validation

Location: Glenshire Drive west of Overland Trail

Pipeline diameter: 14"

Flow Monitor Location

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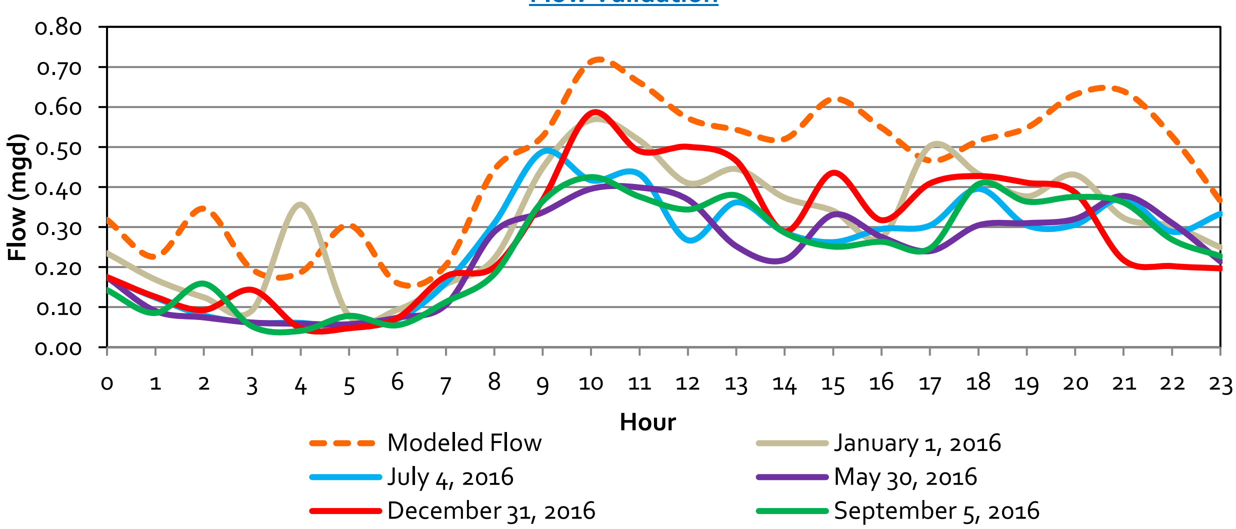
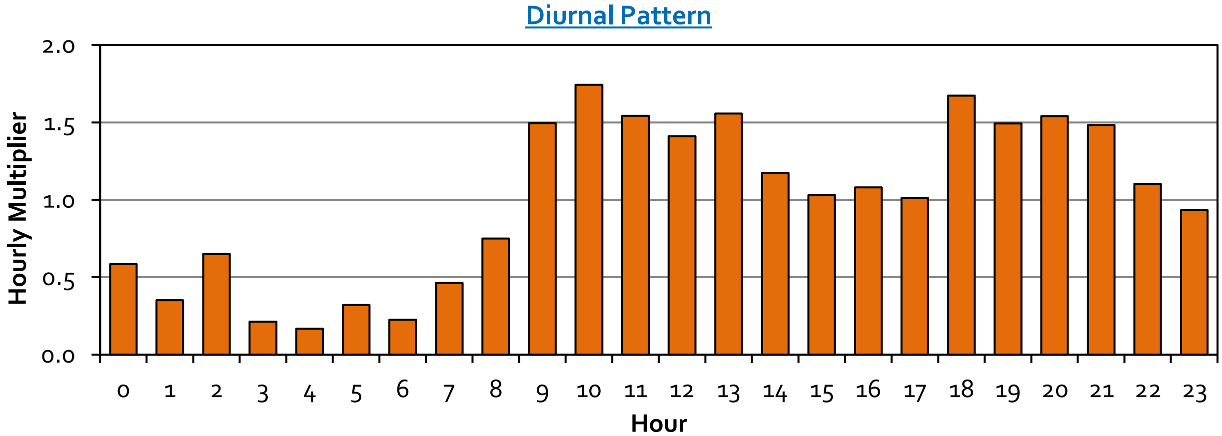



Diurnal Pattern



TRUCKEE SANITARY DISTRICT

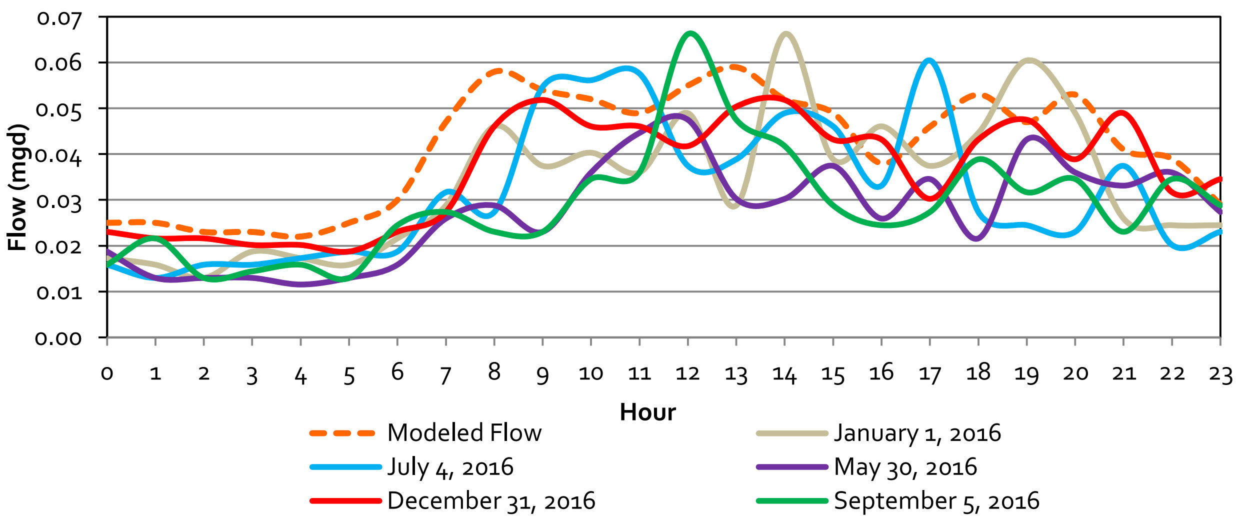
## Flow Monitoring Site A Dry Weather Flow Validation

Location: Donner Pass Road east of Levon Avenue

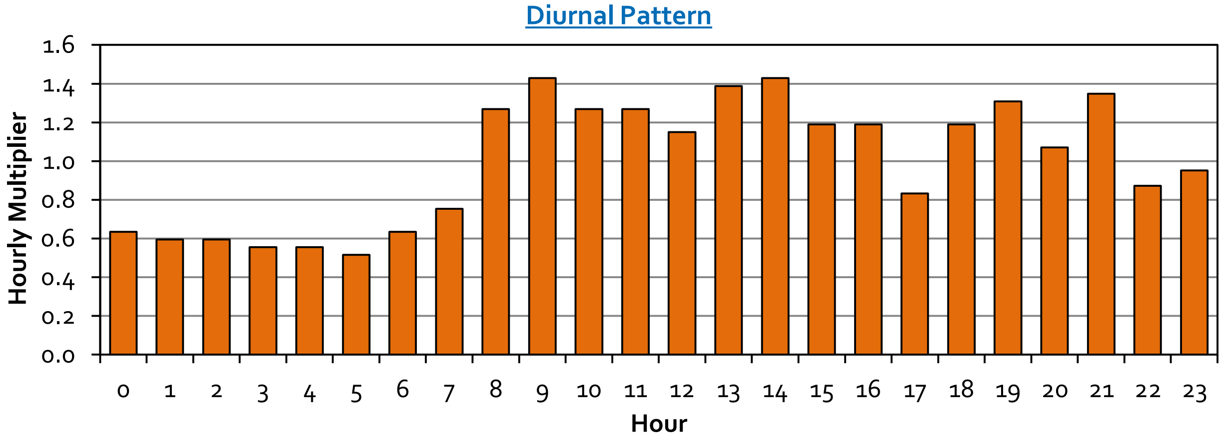
Pipeline diameter: 8"

### Flow Monitor Location


### Flow Validation




### Diurnal Pattern



TRUCKEE SANITARY DISTRICT

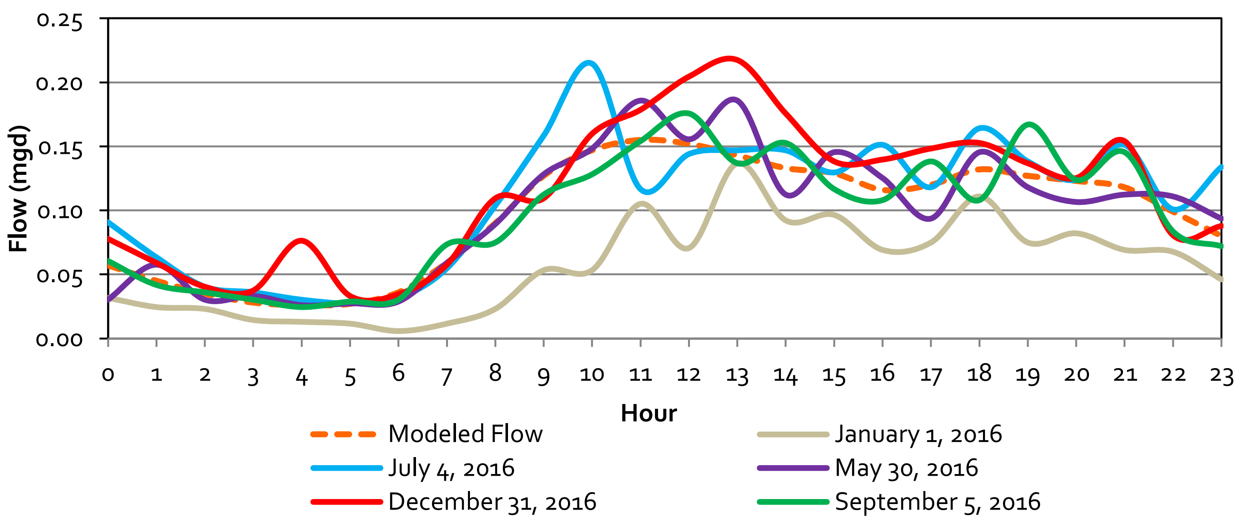
Flow Monitoring Site B Dry Weather Flow Validation

Location: Northeast of I-80 and CA 89

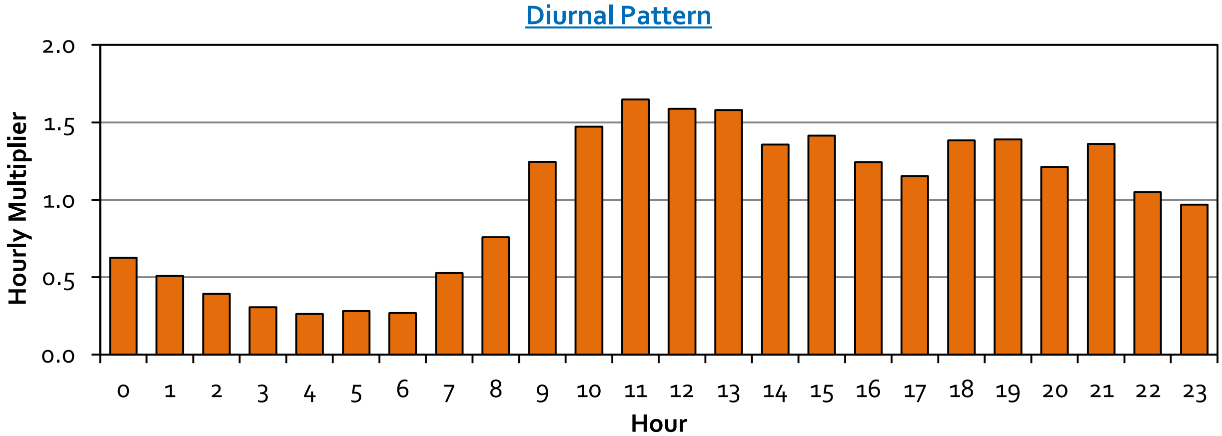
Pipeline diameter: 10"

Flow Monitor Location


Flow Validation




Diurnal Pattern



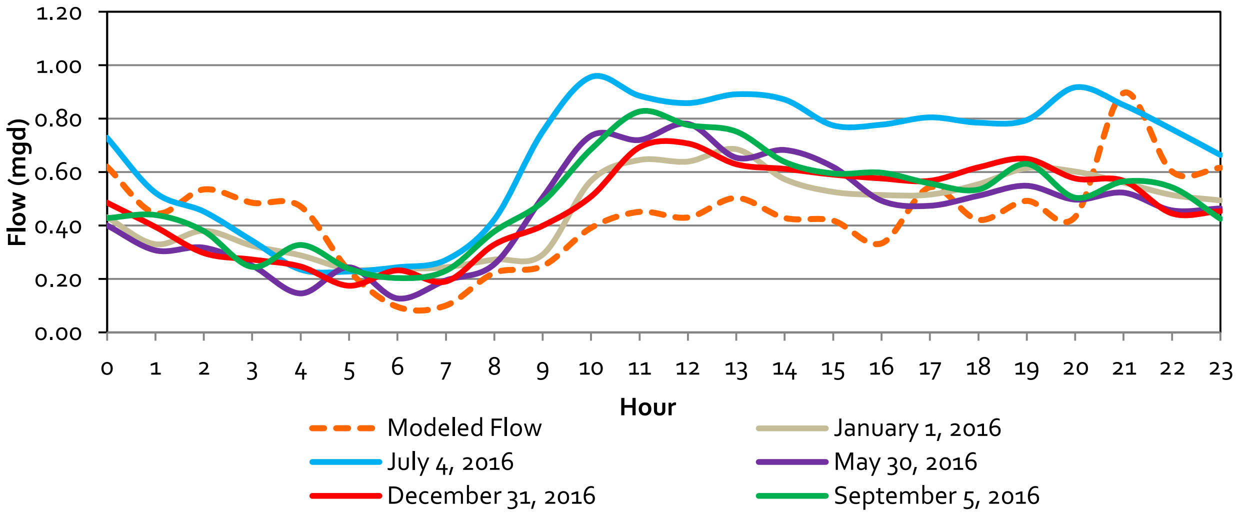
## Flow Monitoring Site C Dry Weather Flow Validation

Location: West River Street and River Park Place

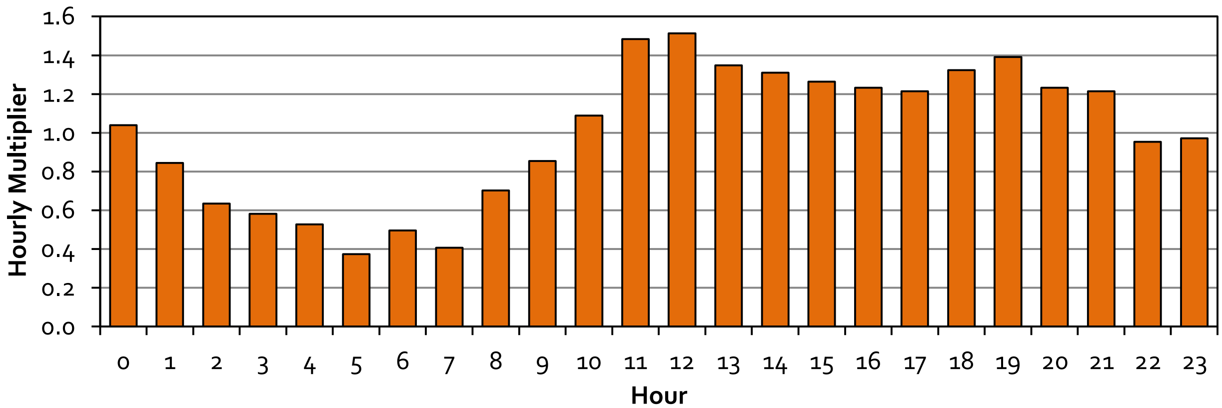
Pipeline diameter: 15"

### Flow Monitor Location


### Flow Validation




### Diurnal Pattern



TRUCKEE SANITARY DISTRICT

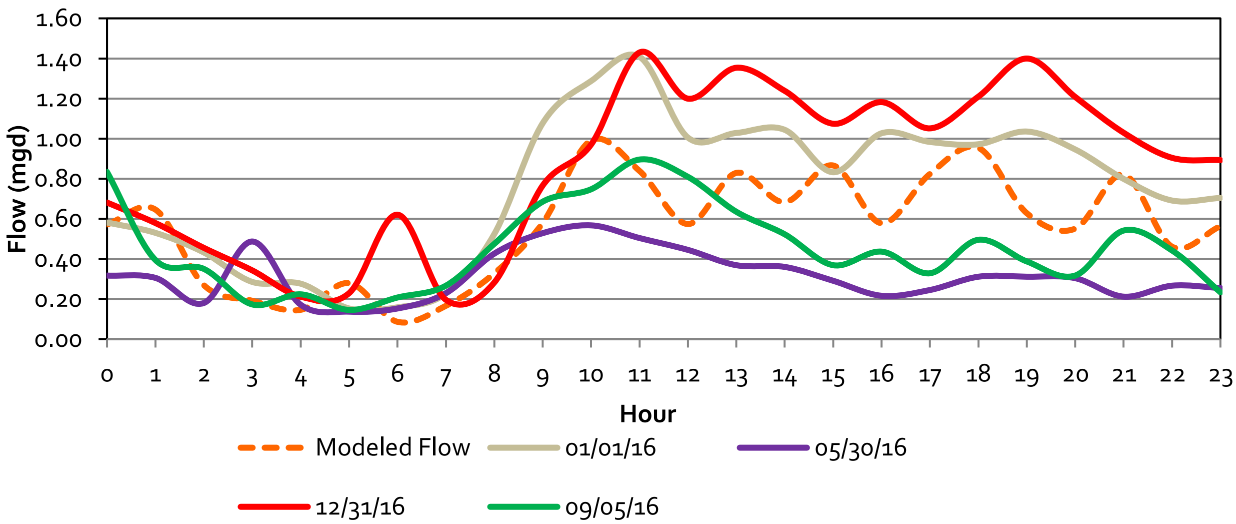
## Flow Monitoring Site APT Dry Weather Flow Validation

Location: Truckee Tahoe Airport Road

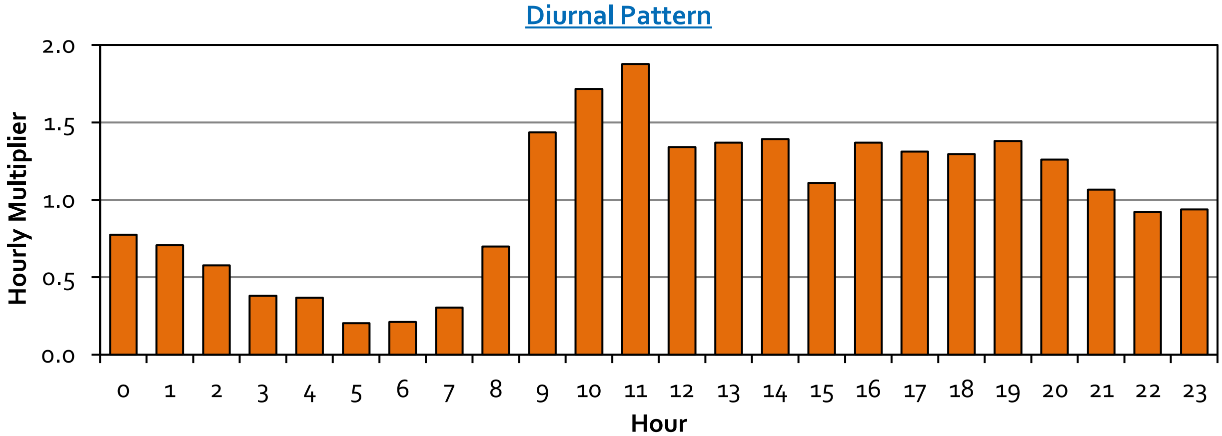
Pipeline diameter: 18"

### Flow Monitor Location


### Flow Validation




### Diurnal Pattern



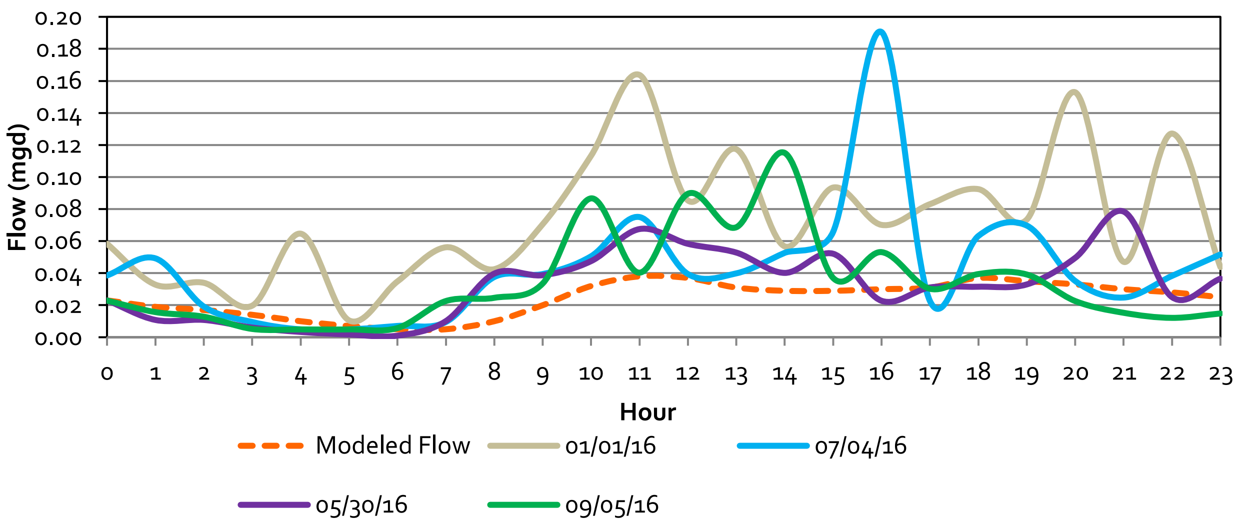
Flow Monitoring Site MC Dry Weather Flow Validation

Location: Schaffer Mill Road, north of Valhalla Drive

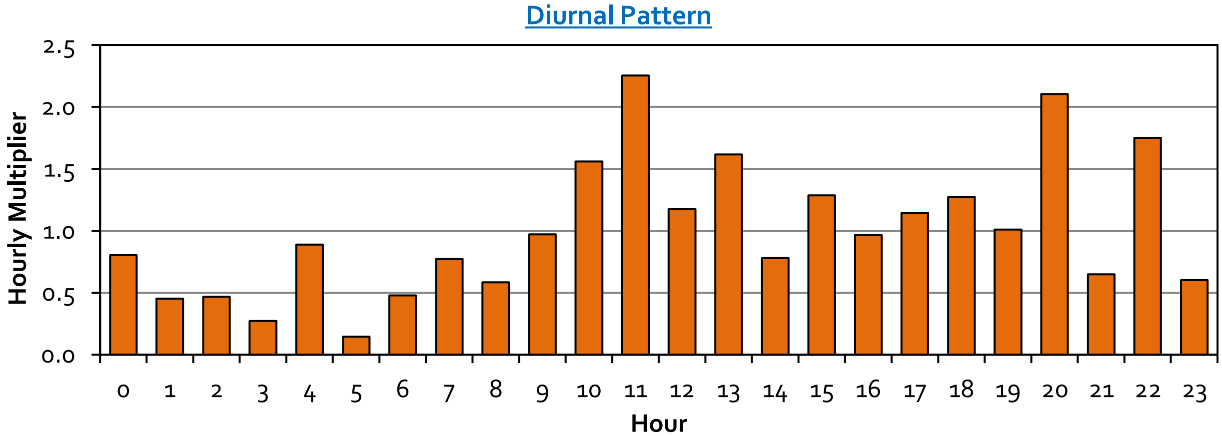
Pipeline diameter: 8"

Flow Monitor Location


Flow Validation




Diurnal Pattern

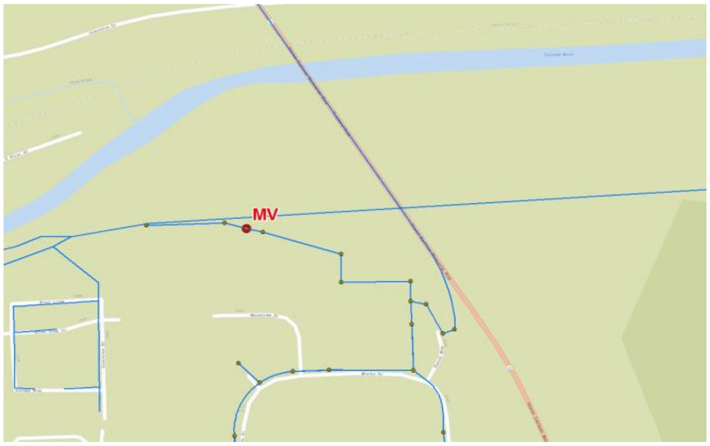


## Flow Monitoring Site MV Dry Weather Flow Validation

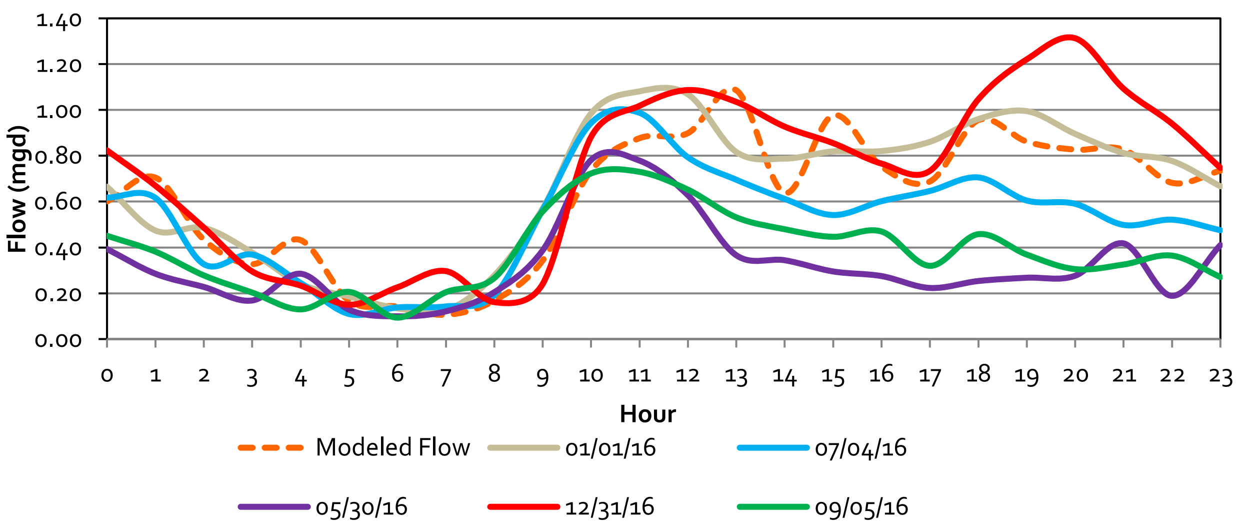
Location: West of Glen Carlson Memorial Boulevard (south of Truckee River)

Pipeline diameter: 18"

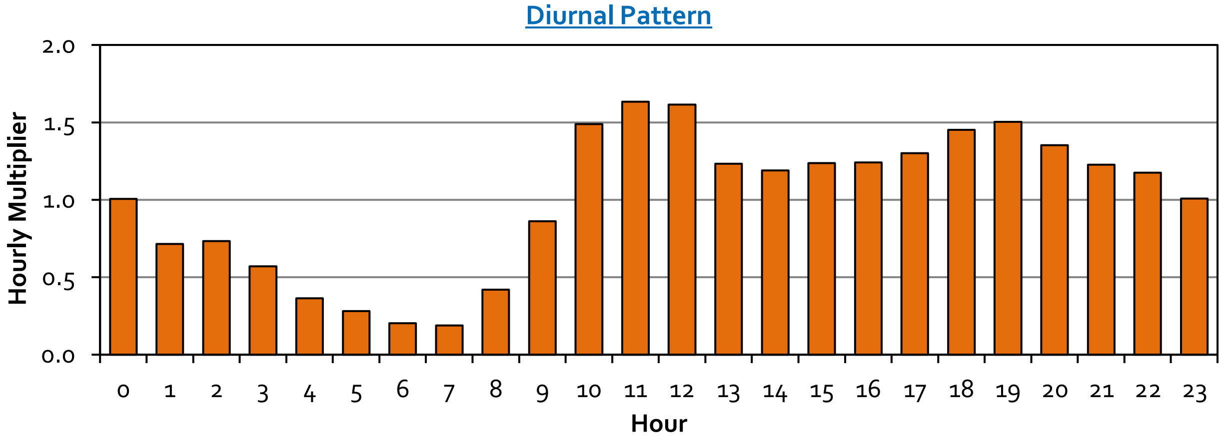
### Flow Monitor Location




### Flow Validation




### Diurnal Pattern

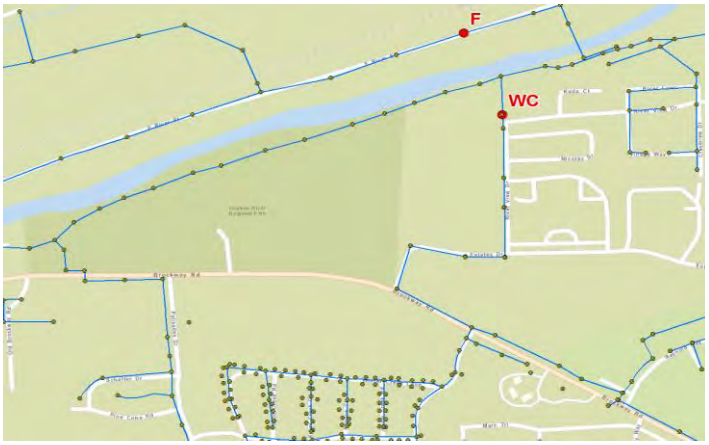


## Flow Monitoring Site WC Dry Weather Flow Validation

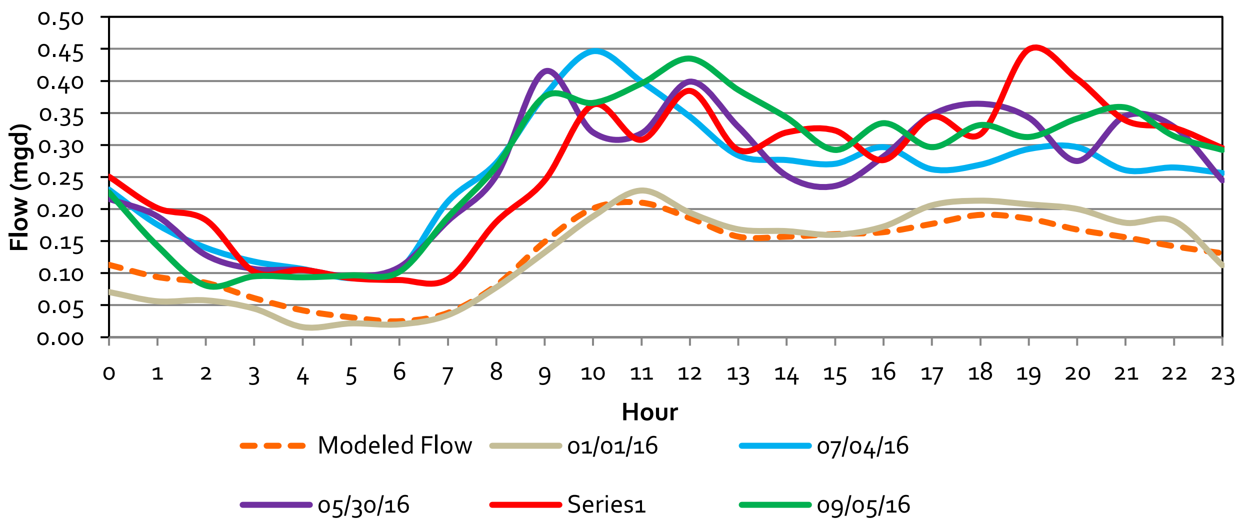
Location: Riverview Drive, south of East River Street

Pipeline diameter: 8"

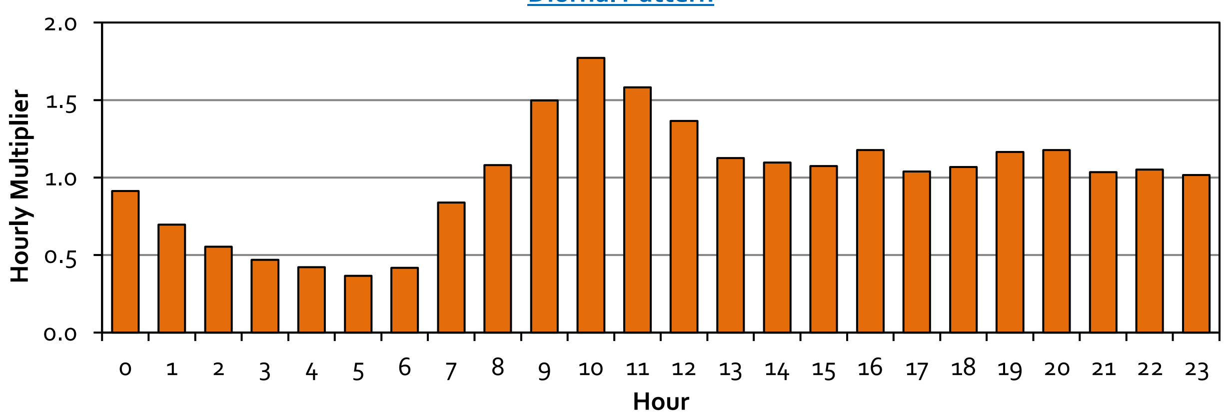
### Flow Monitor Location




### Flow Validation



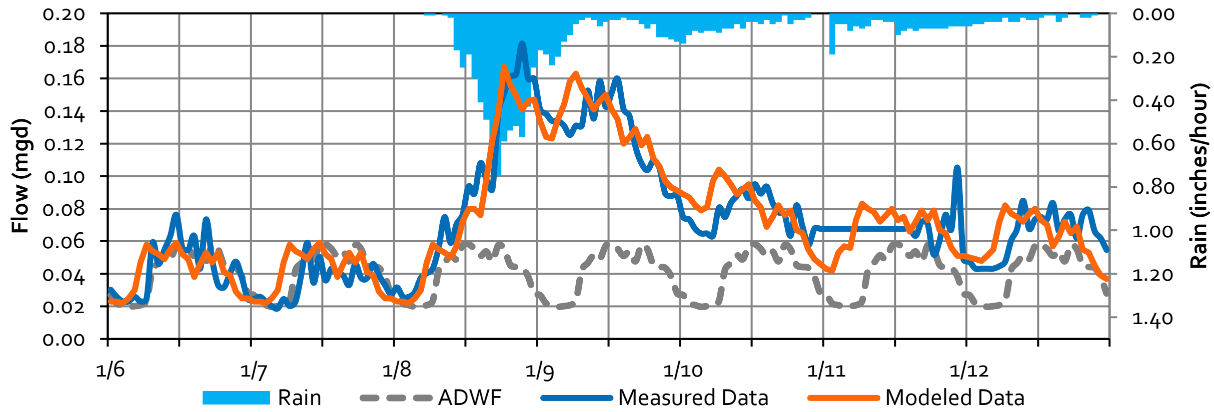

### Diurnal Pattern



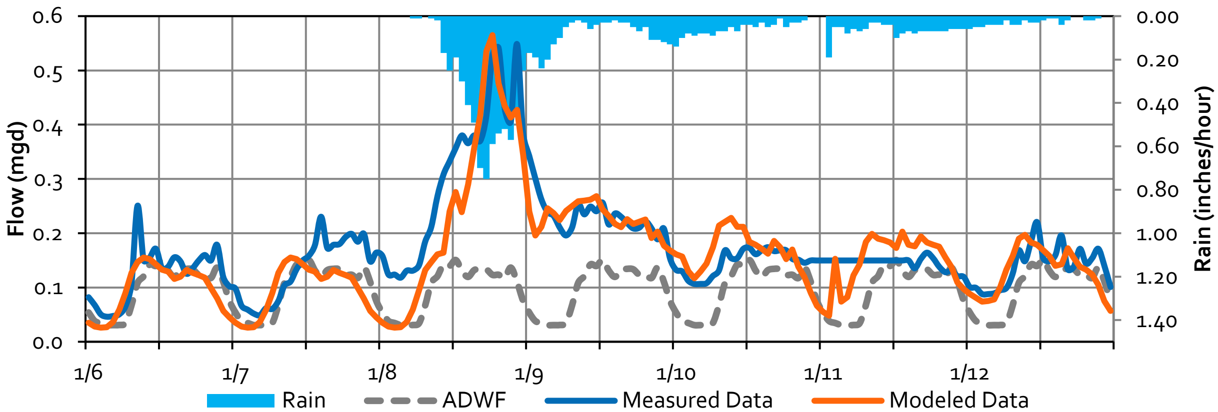
Appendix B

# WET WEATHER FLOW VALIDATION RESULTS

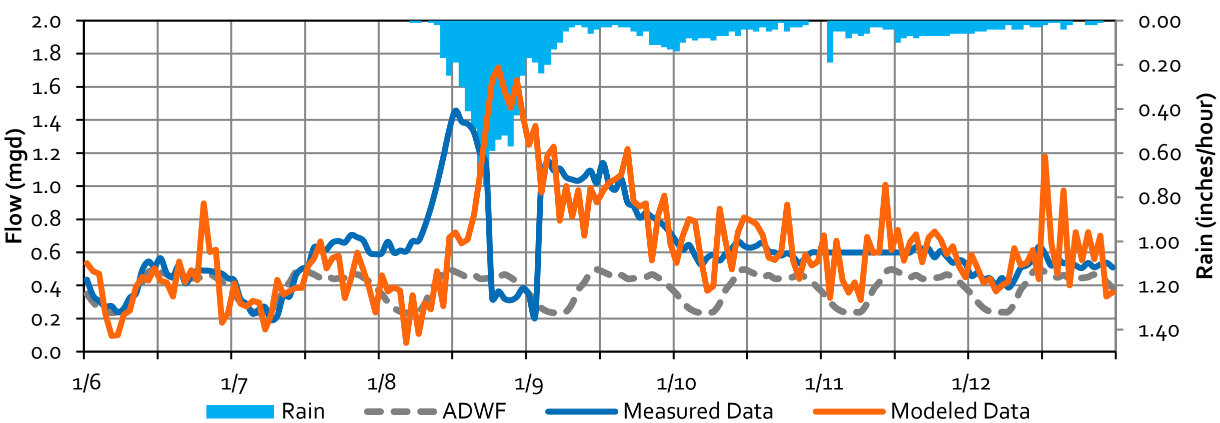
## Meter Site A (Donner Lake)




## Meter Site B (Donner Lake)




## Meter Site C (Donner Lake)

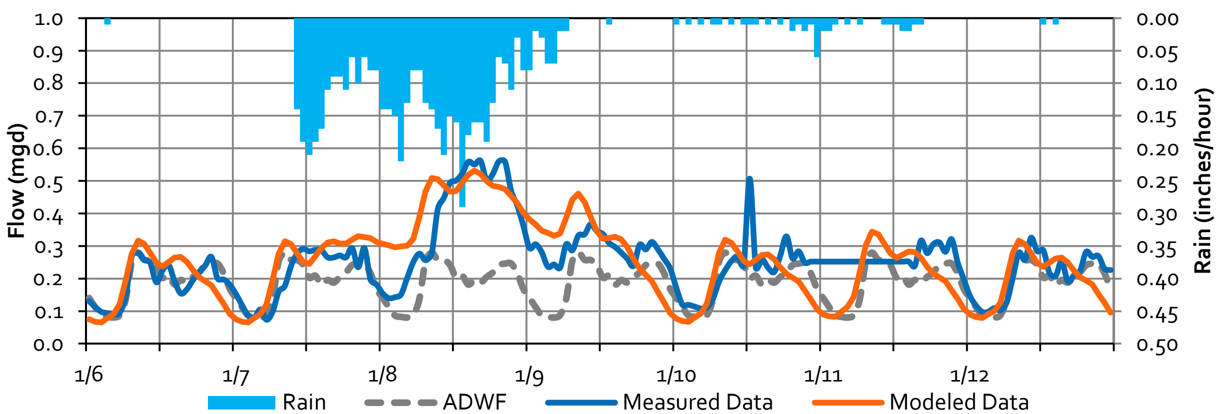



**WET WEATHER VALIDATION**

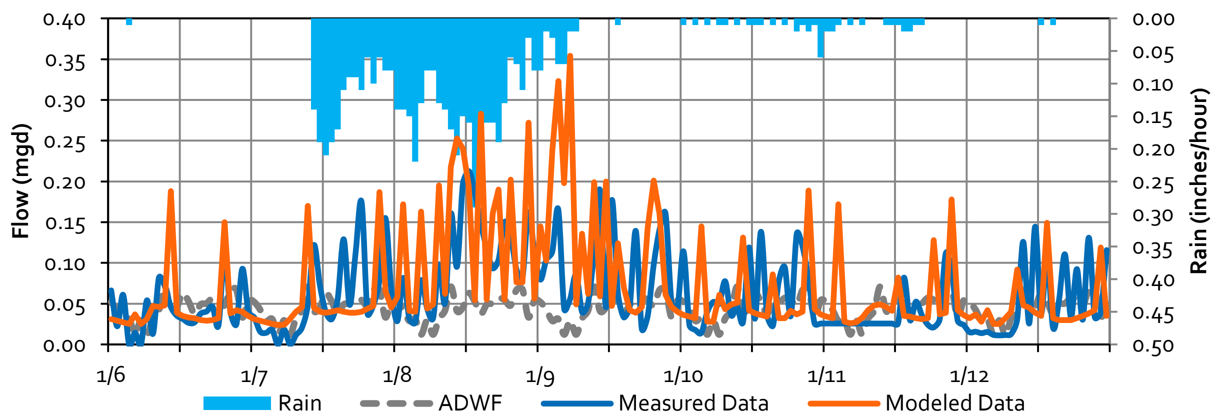
FIGURE B.1

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*

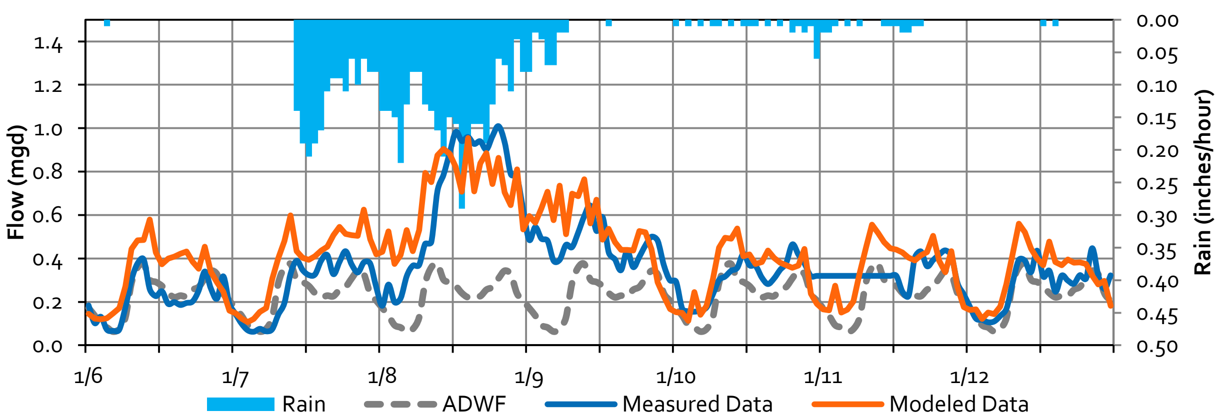
## Meter Site GD (Glenshire)




## Meter Site GC (Glenshire)



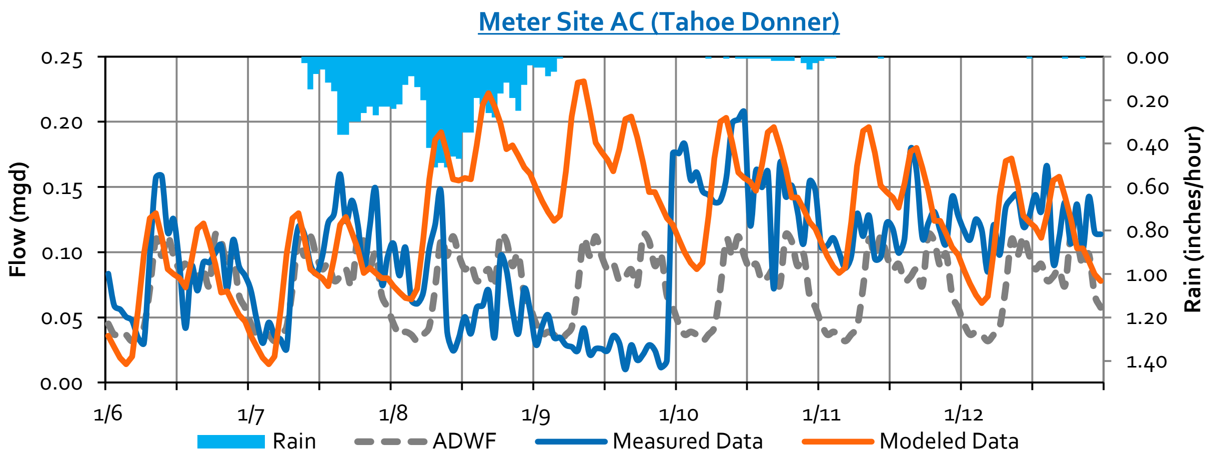

## Meter Site RC (Glenshire)

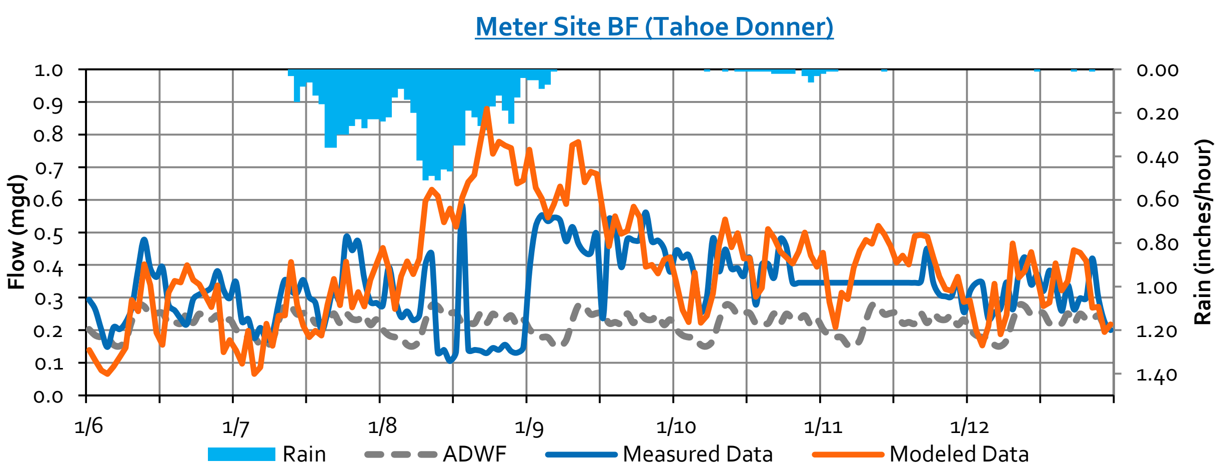


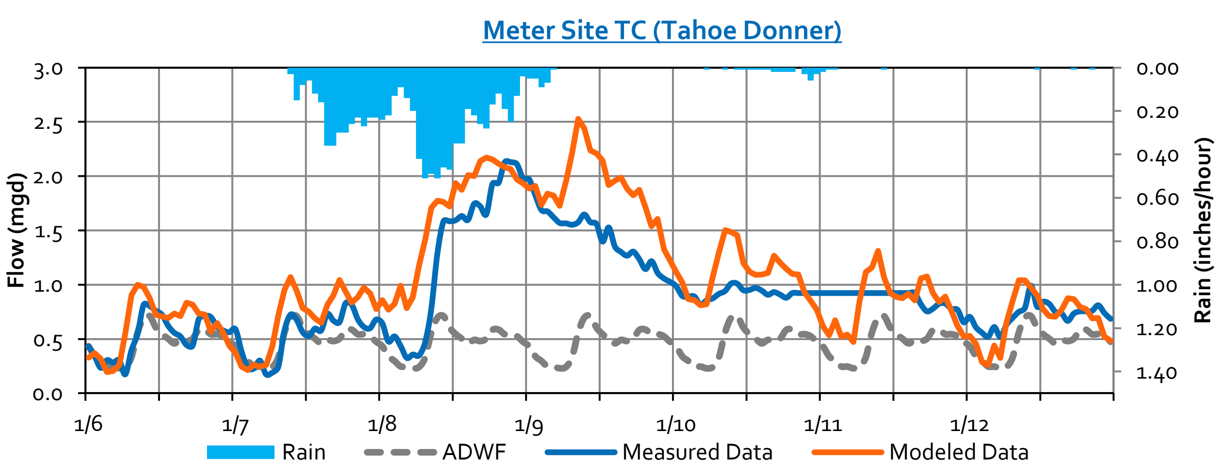

# WET WEATHER VALIDATION

FIGURE B.2

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*




# WET WEATHER VALIDATION

FIGURE B.3

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*

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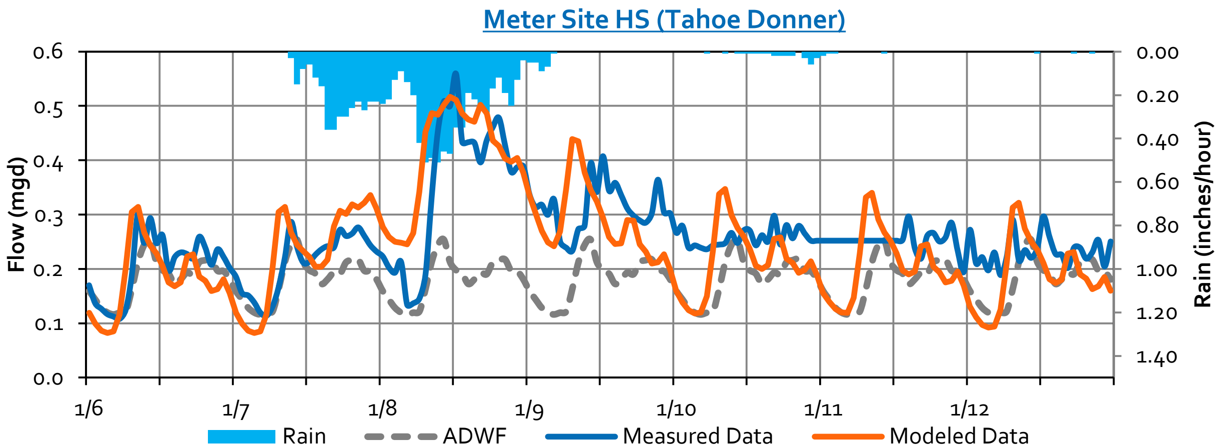


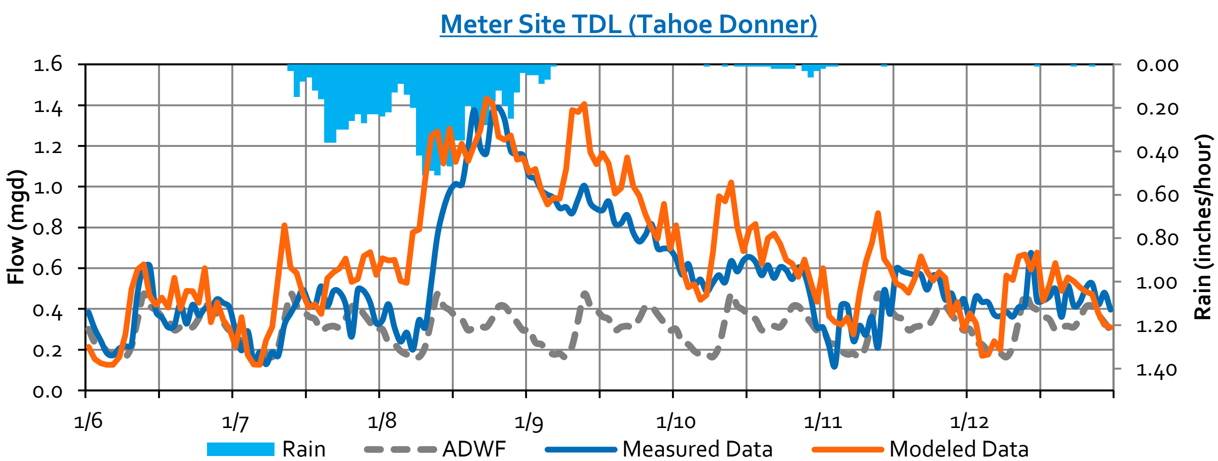


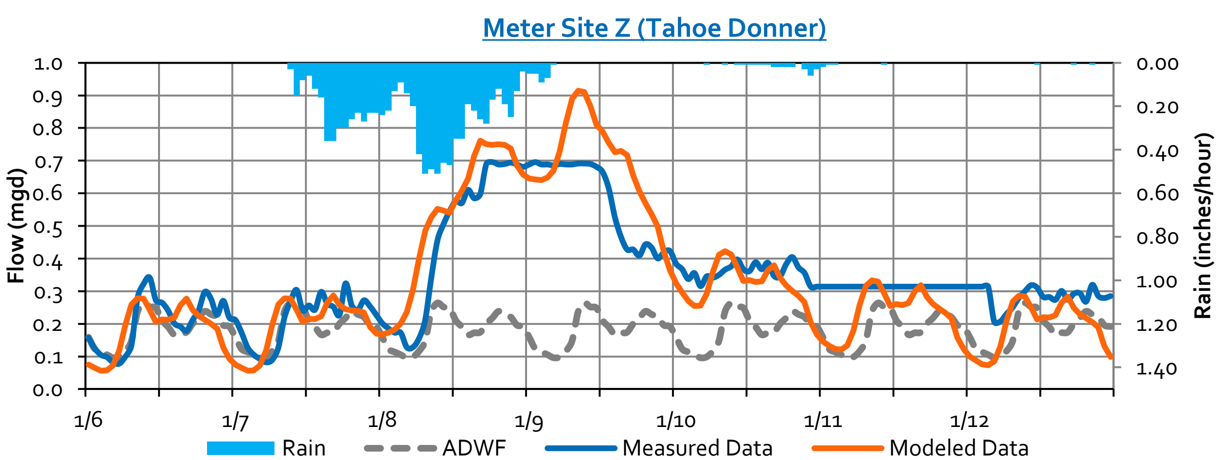


# WET WEATHER VALIDATION

FIGURE B.4

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*

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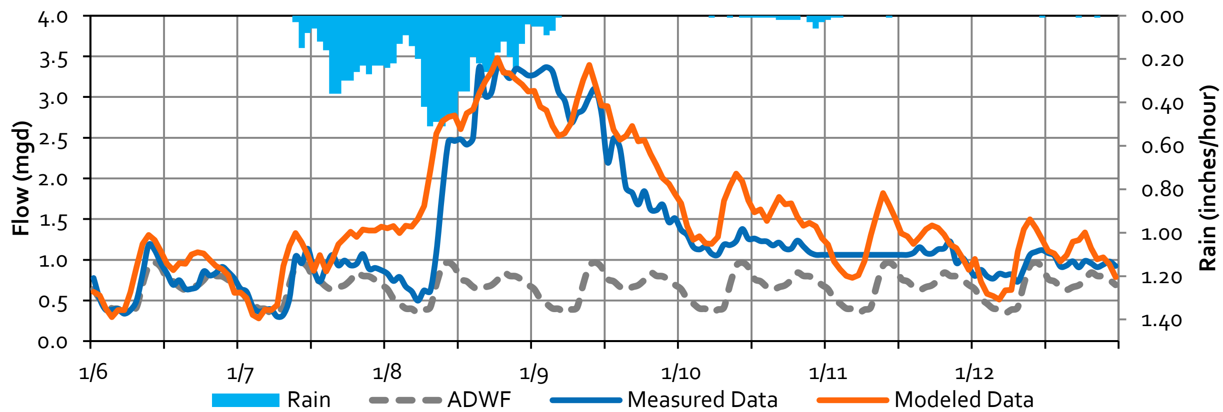
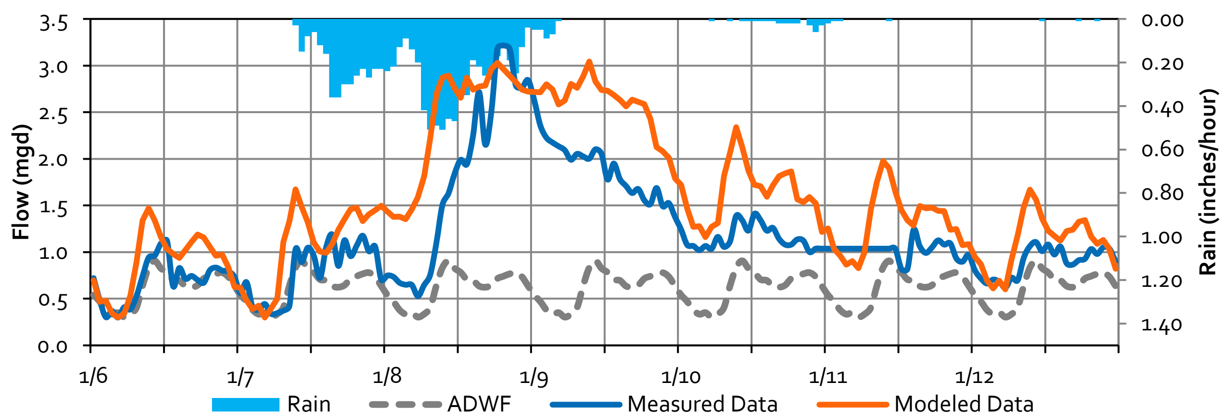
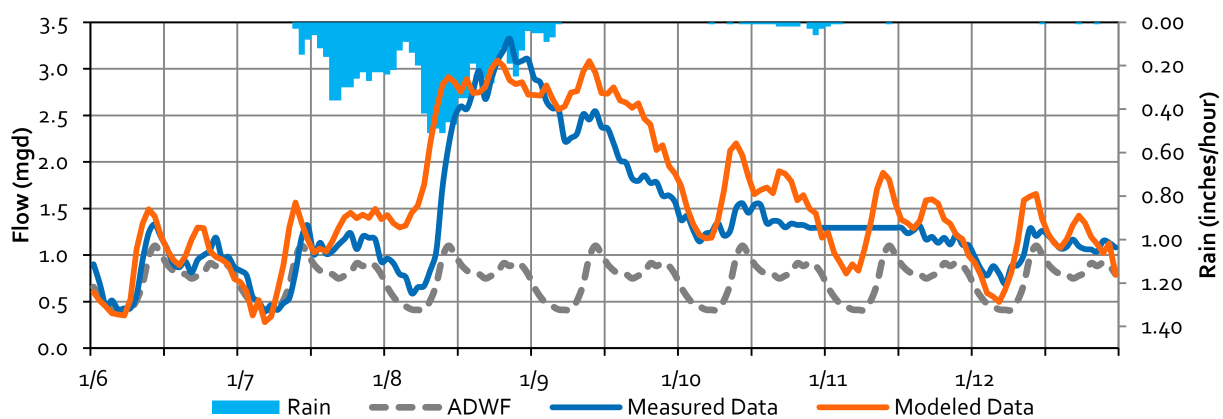
## Meter Site D (Tahoe Donner)




## Meter Site E (Tahoe Donner)




## Meter Site SE (Tahoe Donner)

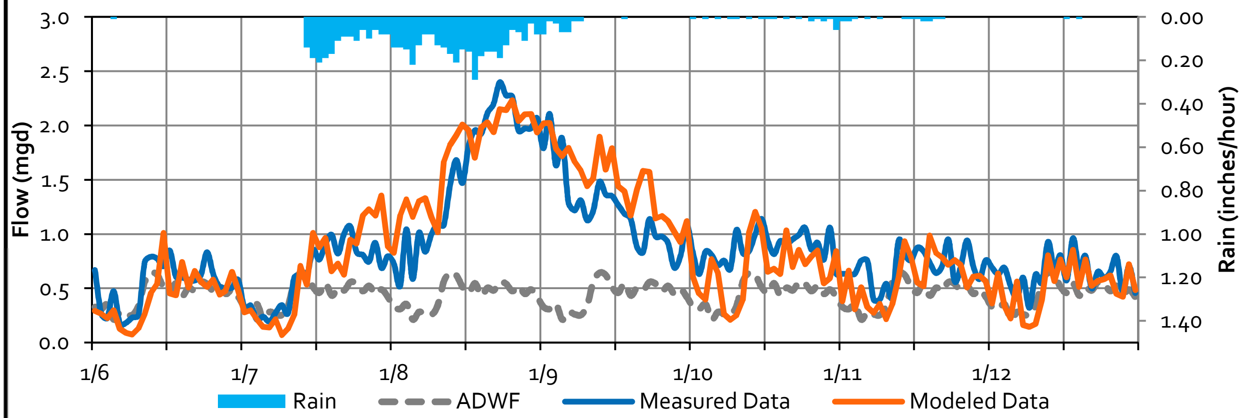



# WET WEATHER VALIDATION

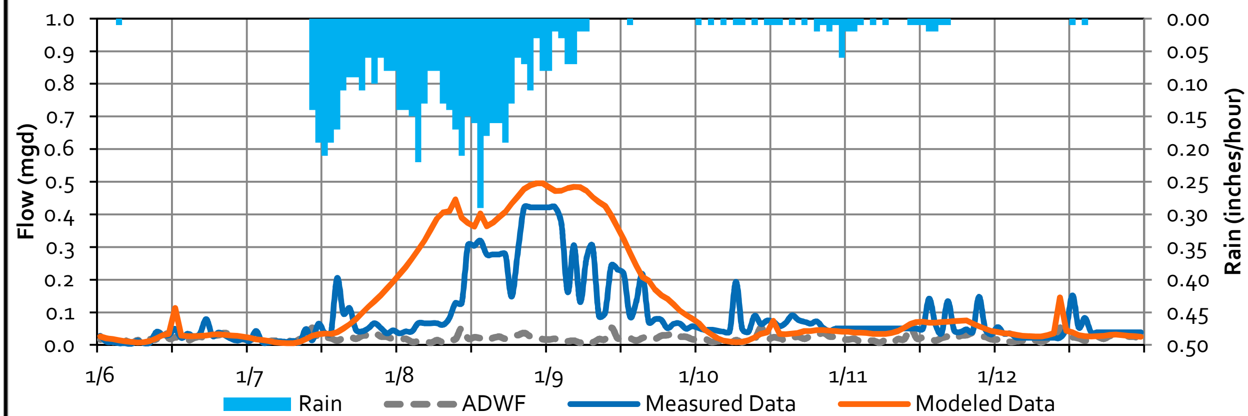
FIGURE B.5

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*

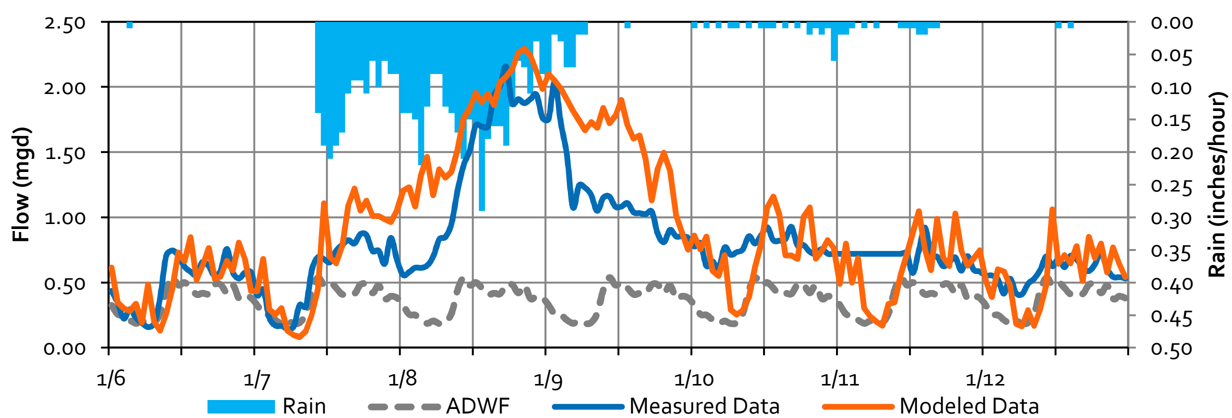
## Meter Site APT (Martis Valley)




## Meter Site MC (Martis Valley)




## Meter Site MV (Martis Valley)




# WET WEATHER VALIDATION

FIGURE B.6

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*

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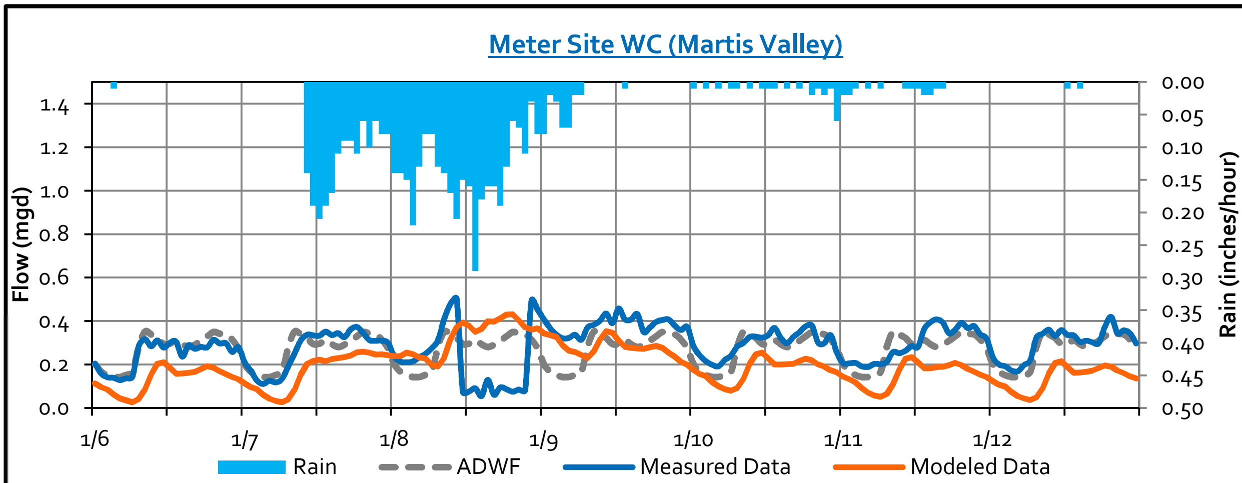


# WET WEATHER VALIDATION

FIGURE B.74

TRUCKEE SANITARY DISTRICT
*HYDRAULIC MODEL 2017*

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